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ABSTRACT

There are two sections to this document: (1) a concept catalog which provides a simple descriptor (a single word or phrase) and number code for each student error identified in the answer matrices for the study guide, pretest, and posttest; and (2) a list of measurable behavioral objectives which give detailed and specific statements of the objectives to be taught for each of the volumes in this first-year algebra series of programed instruction study guides. (Related documents are SE 015 854 - SE 015 870.) (DT)

ED 075201

PROGRAMMED MATH CONTINUUM

level one

ALGEBRA

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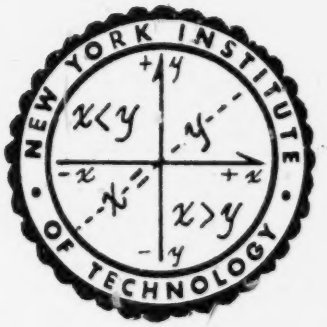

MEASURABLE
BEHAVIORAL
OBJECTIVES

NEW YORK INSTITUTE OF TECHNOLOGY
OLD WESTBURY, NEW YORK

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P R O G R A M M E D M A T H C O N T I N U U M

LEVEL ONE

A L G E B R A

HANDBOOK SUPPLEMENT

CONCEPT CATALOG

MEASURABLE BEHAVIORAL OBJECTIVES

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December 1969

P R O G R A M M E D M A T H C O N T I N U U M

LEVEL ONE

A L G E B R A

C O N C E P T C A T A L O G

New York Institute of Technology

Old Westbury - New York

PROGRAMMED MATHEMATICS CONTINUUM

CONCEPT CATALOG

The concept catalog supplements the two major course outlines.

1. Syllabus - General Topics by Volume and Segment
2. MBO List - Terminal Objective (TO)
   Enabling Objective (EO)
   coded by Volume and Segment

While the MBO's give detailed and specific statements of the objectives to be taught by having each question referenced to a particular MBO, the CONCEPT CATALOG was created to provide a simple descriptor (a single word or phrase) for each error identified that would be suitable for easy computer handling in the

Answer Matrices for :
STUDY GUIDE
PRE-TEST
POST-TEST

The CONCEPT CATALOG descriptors are general and not confined to particular MBO's or particular segments. They are drawn from the four mathematics disciplines and are subdivided into three logical subsets.

The numerical coding is given in the chart below.

	ARITHMETIC	ALGEBRA	TRIGONOMETRY	GEOMETRY
DEFINITIONS	1000-1999	4000-4999	7000-7299	8000-8999
THEOREMS	2000-2999	5000-5999	7300-7599	9000-9499
SKILL	3000-3999	6000-6999	7600-7999	9500-9999

On the following pages a detailed listing of the descriptors is given.

CONCEPT CATALOG

CATALOG OF THE APPERCEPTIVE BASE: RELATIVE TO ARITHMETIC

GENERAL CODE: 1000 - DEFINITIONS

CATALOG NUMBER	DESCRIPTOR	CATALOG NUMBER	DESCRIPTOR
1001	NATURAL NUMBER	1041	BASE
1002	FRACTION	1042	EXPONENT
1003	NUMERATOR	1043	POWER
1004	DENOMINATOR	1044	SQUARE OF A NUMBER
1005	MIXED NUMBER	1045	SQUARE ROOT
1006	IMPROPER FRACTION	1046	CUBE OF A NUMBER
1007	DECIMAL	1047	CUBE ROOT
1008	REPEATING DECIMAL	1048	UNIT OF MEASUREMENT
1009	RATIO	1049	LENGTH AND UNITS
1010	PROPORTION	1050	AREA AND UNITS
1011	PERCENT	1051	VOLUME AND UNITS
1012	BASE	1052	WEIGHT AND UNITS
1013	RATE	1053	TIME AND UNITS
1014	PERCENTAGE	1054	LIQUID MEASURE AND UNITS
1015	DISCOUNT	1055	DRY MEASURE AND UNITS
1016	COMMISSION	1056	DIRECTION AND UNITS
1017	INTEREST	1057	MONEY AND UNITS
1018	PRICE	1058	COMMON DENOMINATOR
1019	NET PRICE	1059	COMMON MULTIPLE
1020	COST	1060	LEAST COMMON DENOMINATOR
1021	NET COST	1061	LEAST COMMON MULTIPLE
1022	PROFIT	1062	LIKE FRACTIONS
1023	NET PROFIT	1063	UNLIKE FRACTIONS
1024	GROSS PROFIT	1064	APPROXIMATE NUMBER
1025	LOSS	1065	SIGNIFICANT DIGIT
1026	FACTOR	1066	BASE OF NUMBER SYSTEM
1027	PRODUCT	1067	ZERO AS PLACE HOLDER
1028	ADDEND	1068	SIGNS OF OPERATIONS
1029	SUM	1069	SYMBOLS OF INCLUSION
1030	MINUEND	1070	EQUALITY
1031	SUBTRAHEND	1071	INEQUALITY
1032	DIFFERENCE	1072	GREATER THAN
1033	DIVIDEND	1073	LESS THAN
1034	DIVISOR	1074	MULTIPLE
1035	QUOTIENT	1075	AVERAGE
1036	REMAINDER	1076	MEANS
1037	RADICAL	1077	EXTREMES
1038	RADICAND	1078	NUMBER LINE
1039	INDEX	1079	NUMERAL
1040	ROOT		

CATALOG OF THE APPERCEPTIVE BASE: RELATIVE TO ARITHMETIC

CODE: 2000 : THEOREMS

CATALOG NUMBER	DESCRIPTOR
2001	COMMUTATIVE LAW: ADDITION
2002	COMMUTATIVE LAW: MULTIPLICATION
2003	ASSOCIATIVE LAW: ADDITION
2004	ASSOCIATIVE LAW: MULTIPLICATION
2005	DISTRIBUTIVE LAW
2006	DIVISION BY ZERO FORBIDDEN
2007	ORDER OF OPERATIONS
2008	PROPORTION LAW
2009	BASE x RATE = PERCENTAGE
2010	RATE x TIME = DISTANCE
2011	LENGTH x WIDTH = AREA
2012	NUMBER x PRICE = COST
2013	NUMBER x UNIT OF MEASURE = TOTAL MEASURE

CATALOG OF THE APPERCEPTIVE BASE: RELATIVE TO ARITHMETIC

CODE: 3000 : SKILLS

CATALOG NUMBER	DESCRIPTOR
3001	ADDING NATURAL NUMBERS
3002	SUBTRACTING NATURAL NUMBERS
3003	MULTIPLYING NATURAL NUMBERS
3004	DIVIDING NATURAL NUMBERS
3005	POWERS NATURAL NUMBERS
3006	SQUARE ROOTS OF NATURAL NUMBERS (TABLE)
3007	REDUCING FRACTIONS
3008	ENLARGING FRACTIONS
3009	ADDING LIKE FRACTIONS
3010	SUBTRACTING LIKE FRACTIONS
3011	ADDING UNLIKE FRACTIONS
3012	SUBTRACTING UNLIKE FRACTIONS
3013	MULTIPLYING FRACTIONS
3014	DIVIDING FRACTIONS
3015	ADDING DECIMALS
3016	SUBTRACTING DECIMALS
3017	MULTIPLYING DECIMALS
3018	DIVIDING DECIMALS
3019	POWERS OF DECIMALS
3020	SQUARE ROOT OF DECIMALS (TABLE)
3021	COMPLETING A PROPORTION
3022	FINDING PERCENTAGE
3023	FINDING RATE
3024	FINDING BASE
3025	COMPARING NATURAL NUMBERS
3026	COMPARING FRACTIONS
3027	COMPARING DECIMALS
3028	CHANGING UNITS
3029	COMPUTING SQUARE ROOT (NATURAL NUMBERS)
3030	COMPUTING SQUARE ROOT (DECIMALS)
3031	APPLYING ORDER OF OPERATIONS
3032	COMPARING NUMBERS ON NUMBER LINE
3033	ROUNDING OFF TO CERTAIN DEGREE OF ACCURACY
3034	CHANGING FRACTION TO FOUR PLACE DECIMAL
3035	FINDING PRIME FACTORS OF A NUMBER
3036	CHANGING A PERCENT TO DECIMAL FORM

CATALOG OF THE APPERCEPTIVE BASE RELATIVE TO ALGEBRA

GENERAL CODE: 4000 : DEFINITIONS

CATALOG NUMBER	DESCRIPTOR
4001	ADOPTION OF THE ALGORITHMS OF ARITHMETIC
4002	FACTOR
4003	LITERAL FACTOR
4004	NUMERICAL FACTOR
4005	COEFFICIENT
4006	TERM
4007	SIMILAR TERMS
4008	UNLIKE TERMS
4009	BASE
4010	EXPONENT
4011	FUNCTION
4012	RELATION
4013	FORMULA
4014	EQUATION
4015	IDENTITY
4016	MONOMIAL
4017	BINOMIAL
4018	FIRST DEGREE
4019	SIGNED NUMBER
4020	DIRECTED SEGMENT
4021	ABSOLUTE VALUE
4022	TRINOMIAL
4023	POLYNOMIAL
4024	FACTORING
4025	LINEAR EQUATION
4026	QUADRATIC EQUATION
4027	DIRECT VARIATION
4028	INVERSE VARIATION
4029	RECIPROCAL
4030	SET
4031	ELEMENT
4032	SUBSET
4033	PROPER SUBSET
4034	SOLUTION SET
4035	ROSTER
4036	RULE
4037	DOMAIN
4038	RANGE
4039	ONE-TO-ONE CORRESPONDENCE
4040	OPEN EXPRESSION
4041	UNION OF SETS
4042	INTERSECTION OF SETS
4043	ORDERED PAIR
4044	VARIABLE
4045	REAL NUMBER
4046	SCIENTIFIC NOTATION
4047	LOWEST COMMON MULTIPLE
4048	LITERAL EXPONENT
4049	ZERO EXPONENT
4050	FRACTIONAL EXPONENT
4051	NEGATIVE EXPONENT
4052	QUADRATIC FORM
4053	COORDINATE PLANE
4054	RATIONAL NUMBER
4055	IRRATIONAL NUMBER
4056	REAL NUMBER
4057	EMPTY SET
4058	JOINT VARIATION
4059	ABSCISSA OF A POINT
4060	ORDINATE OF A POINT
4061	ORIGIN
4062	INFINITE SET
4063	BAR NOTATION
4064	CONJUGATE BINOMIAL SURD
4065	SIMILAR RADICALS
4066	EXPONENT 1
4067	BASE TO WHICH EXPONENT APPLIES
4068	ASCENDING ORDER OF POWERS IN POLYNOMIAL
4069	DESCENDING ORDER OF POWERS IN POLYNOMIAL
4070	DEGREE OF TERM
4071	DEGREE OF EQUATION
4072	PRIME FACTOR OF ALGEBRAIC EXPRESSION
4073	QUADRATIC EXPRESSION
4074	COMPLEX FRACTIONS
4075	SLOPE OF A LINE
4076	Y INTERCEPT OF A LINE
4077	X INTERCEPT OF A LINE
4078	DELTA Y
4079	DELTA X
4080	COORDINATES
4081	X AXIS
4082	Y AXIS
4083	FINITE SET
4084	IMPROPER SUBSET
4085	SLOPE OF LINE: $\Delta Y/\Delta X$
4086	FRACTIONAL EQUATION
4087	LOWEST COMMON DENOMINATOR

CATALOG OF THE APPERCEPTIVE BASE RELATIVE TO ALGEBRA

GENERAL CODE: 5000 PRINCIPLE: THEOREM

CATALOG NUMBER	DESCRIPTOR
5001	REFLEXIVE
5002	SYMMETRIC PROPERTY
5003	TRANSITIVE PROPERTY
5004	CLOSURE PROPERTY: ADDITION
5005	CLOSURE PROPERTY: MULTIPLICATION
5006	SUBSTITUTION
5007	COMMUTATIVE PROPERTY: ADDITION
5008	COMMUTATIVE PROPERTY: MULTIPLICATION
5009	ASSOCIATIVE PROPERTY: ADDITION
5010	ASSOCIATIVE PROPERTY: MULTIPLICATION
5011	DISTRIBUTIVE PROPERTY: MULTIPLICATION OVER ADDITION
5012	DISTRIBUTIVE PROPERTY: MULTIPLICATION OVER SUBTRACTION
5013	MULTIPLICATIVE PROPERTY OF 1
5014	ADDITIVE PROPERTY OF 0
5015	MULTIPLICATIVE PROPERTY OF 0
5016	DIVISION BY ZERO IS IMPOSSIBLE
5017	ADDITION AXIOM
5018	SUBTRACTION AXIOM
5019	DIVISION AXIOM
5020	MULTIPLICATION AXIOM
5021	ADDITION OF TWO POSITIVE NUMBERS
5022	ADDITION OF TWO NEGATIVE NUMBERS
5023	ADDITION OF POSITIVE AND SMALLER NEGATIVE
5024	ADDITION OF POSITIVE AND LARGER NEGATIVE
5025	SUBTRACTION IS ADDITION OF INVERSE
5026	MULTIPLICATION OF TWO POSITIVES
5027	MULTIPLICATION OF POSITIVE AND NEGATIVE
5028	MULTIPLICATION OF TWO NEGATIVES
5029	DIVISION IS MULTIPLICATION BY RECIPROCAL
5030	MULTIPLICATIVE PROPERTY OF -1
5031	MULTIPLICATION OF RECIPROCALS
5032	ORDER PROPERTY (COMPARISION OF TWO NUMBERS)
5033	TRANSITIVE PROPERTY (LESS THAN)
5034	TRANSITIVE PROPERTY (MORE THAN)
5035	ADDITION OF EQUALS TO INEQUALITY (LESS THAN)
5036	SUBTRACTION OF EQUALS FROM INEQUALITY (LESS THAN)
5037	ADDITION OF EQUALS TO INEQUALITY (MORE THAN)
5038	SUBTRACTION OF EQUALS FROM INEQUALITY (MORE THAN)
5039	MULTIPLICATION OF INEQUALITY BY POSITIVE NUMBER
5040	MULTIPLICATION OF INEQUALITY BY ZERO
5041	MULTIPLICATION OF INEQUALITY BY NEGATIVE NUMBER
5042	DIVISION OF INEQUALITY BY POSITIVE NUMBER
5043	DIVISION OF INEQUALITY BY NEGATIVE NUMBER

CATALOG NUMBER	DESCRIPTOR
5044	MULTIPLICATION OF EXPONENTIAL TERMS
5045	DIVISION OF EXPONENTIAL TERMS (NUMERATOR LARGER)
5046	GROUPING EXPONENTS
5047	POWER LAW
5048	DIVISION OF EXPONENTIAL TERMS (NUMERATOR SMALLER)
5049	REMOVING COMMON FACTOR
5050	FACTOR DIFFERENCE: OF TWO SQUARES
5051	FACTOR TRINOMIAL SQUARE (SUMS)
5052	FACTOR TRINOMIAL SQUARE (DIFFERENCES)
5053	FACTOR GENERAL QUADRATIC TRINOMIAL
5054	FACTOR QUADRINOMIAL BY GROUPING
5055	REDUCTION OF FRACTIONS
5056	MULTIPLICATION OF FRACTIONS
5057	DIVISION OF FRACTIONS
5058	ADDITION LIKE FRACTIONS
5059	SUBTRACTION LIKE FRACTIONS
5060	GENERAL ADDITION OF FRACTIONS
5061	GENERAL SUBTRACTION OF FRACTIONS
5062	PROPORTION RULE
5063	QUADRATIC EQUATION SOLUTION FORMULA
5064	FACTORS OF ZERO
5065	MULTIPLICATION OF SURDS
5066	ADDITION LIKE RADICALS
5067	FACTOR TRINOMIAL (NEGATIVE X TERM, POSITIVE CONSTANT)
5068	FACTOR TRINOMIAL (POSITIVE X TERM, NEGATIVE CONSTANT)
5069	FACTOR TRINOMIAL (NEGATIVE X TERM, NEGATIVE CONSTANT)
5070	TERMINATING AND REPEATING DECIMALS EQUIVALENT TO RATIONALS
5071	TAKING SQUARE ROOT OF BOTH SIDES OF EQUATION
5072	SQUARE OF A SQUARE ROOT
5073	MULTIPLICATION OF RADICALS
5074	DIVISION OF RADICALS
5075	CLOSURE - SUBTRACTION OF RATIONAL NUMBERS
5076	CLOSURE - DIVISION OF RATIONAL NUMBERS
5077	COMPARISION OF FRACTIONS
5078	DENSITY PROPERTY OF RATIONAL NUMBERS
5079	DIRECT PROPORTION
5080	INVERSE PROPORTION
5081	DIVISION OF RADICALS
5082	DISTRIBUTIVE PROPERTY OF DIVISION OVER ADDITION AND MULTIPLICATION
5083	EVERY QUADRATIC EQUATION HAS TWO ROOTS NOT NECESSARILY IN REAL DOMAIN
5084	EQUIVALENCE OF DERIVED EQUATIONS
5085	ADDITION ON A NUMBER LINE

CATALOG OF APPERCEPTIVE BASE RELATIVE TO ALGEBRA

GENERAL CODE 6000 - SKILLS

CATALOG NUMBER	DESCRIPTOR
6001	SUBSTITUTING LETTERS FOR WORDS
6002	SUBSTITUTING ALGEBRAIC FORMULAS FOR LAWS
6003	EVALUATING ALGEBRAIC EXPRESSIONS: BY SUBSTITUTION OF GIVEN VALUES
	BASIC LAWS OF COMBINATION
6004	APPLYING THE ORDER OF OPERATIONS
6005	APPLYING THE COMMUTATIVE LAW FOR ADDITION
6006	APPLYING THE COMMUTATIVE LAW FOR MULTIPLICATION
6007	APPLYING THE ASSOCIATIVE LAW FOR ADDITION
6008	APPLYING THE ASSOCIATIVE LAW FOR MULTIPLICATION
6009	APPLYING THE DISTRIBUTIVE LAW
	SOLUTION OF EQUATIONS
6010	SOLVING EQUATIONS BY ADDITION AXIOM
6011	SOLVING EQUATIONS BY SUBTRACTION AXIOM
6012	SOLVING EQUATIONS BY MULTIPLICATION AXIOM
6013	SOLVING EQUATIONS BY DIVISION AXIOM
6014	SOLVING EQUATIONS BY COMBINATION OF AXIOMS
	OPERATIONS WITH SIGNED NUMBERS
6015	ADDING SIGNED NUMBERS
6016	SUBTRACTING SIGNED NUMBERS
6017	MULTIPLYING SIGNED NUMBERS
6018	DIVIDING SIGNED NUMBERS
	OPERATIONS WITH TERMS
6019	ADDING MONOMIALS
6020	ADDING POLYNOMIALS
6021	SUBTRACTING MONOMIALS
6022	SUBTRACTING POLYNOMIALS
6023	MULTIPLYING MONOMIALS BY MONOMIAL
6024	MULTIPLYING POLYNOMIAL BY MONOMIAL
6025	MULTIPLYING POLYNOMIAL BY POLYNOMIAL
6026	DIVIDING MONOMIAL BY MONOMIAL
6027	DIVIDING POLYNOMIAL BY MONOMIAL
6028	DIVIDING POLYNOMIAL BY POLYNOMIAL
6029	ANALYZING FUNCTIONAL DEPENDENCE
6030	TABULAR VALUES FOR RELATIONSHIPS

(ALGEBRAIC SKILLS CONTINUED)

CATALOG NUMBER	DESCRIPTOR
	SIMULTANEOUS LINEAR EQUATIONS:
6031	SOLVING SIM. LINEAR BY ADDITION
6032	SOLVING SIM. LINEAR BY SUBTRACTION
6033	SOLVING SIM. LINEAR BY SUBSTITUTION
	FACTORIZATION OF POLYNOMIALS:
6034	REMOVING HIGHEST COMMON FACTOR
6035	MULTIPLYING THE SUM AND DIFFERENCE OF TWO TERMS
6036	FACTORING THE DIFFERENCE OF TWO SQUARES
6037	FACTORING TRINOMIALS
	OPERATIONS ON FRACTIONS:
6038	REDUCING FRACTIONS
6039	MULTIPLYING FRACTIONS
6040	DIVIDING FRACTIONS
6041	ADDING LIKE ALGEBRAIC FRACTIONS
6042	ADDING UNLIKE FRACTIONS WITH MONOMIAL DENOMINATIONS
6043	ADDING UNLIKE FRACTIONS WITH BINOMIAL DENOMINATORS
6044	ANALYZING VARIATION IN FRACTIONS
	SPECIAL COMPUTATIONS:
6045	COMPUTING SQUARE ROOT OF A NUMBER
6046	SIMPLIFYING THE SQUARE ROOT OF A PRODUCT
6047	SIMPLIFYING THE SQUARE ROOT OF A FRACTION
6048	ADDING LIKE RADICALS
6049	MULTIPLYING SQUARE ROOTS
6050	DIVIDING SQUARE ROOTS
6051	RATIONALIZING A MONOMIAL SQUARED DENOMINATOR
	SOLUTION OF QUADRATIC EQUATIONS:
6052	SOLVING EQUATIONS INVOLVING RADICALS
6053	SOLVING QUADRATIC EQUATIONS BY FACTORING
6054	SOLVING QUADRATICS BY COMPLETING THE SQUARE
6055	SOLVING QUADRATICS BY FORMULA
6056	SOLVING DIRECT VARIATION PROBLEMS
6057	SOLVING INVERSE VARIATION PROBLEMS
	SOLUTION OF SPECIAL EQUATIONS:
6058	SOLVING SIMPLE QUADRATICS BY TAKING THE SQUARE ROOT OF BOTH SIDES
6059	SOLVING RADICAL EQUATIONS BY SQUARING BOTH SIDES
6060	SOLVING EQUATIONS WITH INTEGRAL COEFFICIENTS
6061	SOLVING EQUATIONS WITH FRACTIONAL COEFFICIENTS
6062	SOLVING EQUATIONS WITH THE UNKNOWN IN THE DENOMINATOR
6063	SOLVING OF EQUATIONS REQUIRING COMBINING UNKNOWNS FIRST

(ALGEBRAIC SKILLS CONTINUED)

CATALOG NUMBER	DESCRIPTOR
	GRAPHING LINEAR EQUATIONS:
6064	GRAPHING LINEAR EQUATIONS BY THE TWO INTERCEPT METHOD
6065	GRAPHING LINEAR EQUATIONS BY SLOPE-INTERCEPT METHOD
6066	FINDING THE SLOPE OF A LINE GIVEN THE EQUATION
6067	SOLVING SIMULTANEOUS LINEAR EQUATIONS BY GRAPHICAL METHOD
6068	SOLVING SIMULTANEOUS LINEAR INEQUALITIES BY GRAPHICAL METHOD
6069	CHANGING A REPEATING DECIMAL TO A COMMON FRACTION
6070	USING PYTHAGOREAN RELATION
6071	SETTING UP A PROPORTION FOR SIDES OF SIMILAR TRIANGLES
	SELECTION OF IMPLICIT RELATIONSHIPS:
6072	SOLVING NUMBER PROBLEMS
6073	SOLVING CONSECUTIVE NUMBER PROBLEMS
6074	SOLVING COIN PROBLEMS
6075	SOLVING MIXTURE PROBLEMS
6076	SOLVING MOTION PROBLEMS
6077	SOLVING INVESTMENT PROBLEMS
6078	SOLVING AGE PROBLEMS
6079	SOLVING AVERAGE PROBLEMS
6080	SOLVING RATIO PROBLEMS
6081	SOLVING PURCHASING PROBLEMS
6082	SOLVING PERIMETER PROBLEMS
6083	SOLVING AREA PROBLEMS
6084	SOLVING DIGIT PROBLEMS
6085	SOLVING WORK PROBLEMS
6086	SOLVING PERCENT PROBLEMS
6087	SOLVING PROBLEMS WITH ONE VARIABLE
6088	SOLVING PROBLEMS WITH TWO VARIABLES
6089	DETERMINING THE EQUATION OF A LINE THROUGH TWO POINTS
6090	CONSTRUCTING A DIAGRAM FOR A VERBAL PROBLEM
6091	RATIONALIZING BINOMIAL DENOMINATOR
6092	SOLVING VERBAL PROBLEMS BY ALGEBRAIC EQUATION
6093	SOLVING VERBAL PROBLEMS BY GRAPHICAL METHODS
6094	SOLVING VERBAL PROBLEMS BY TRIGONOMETRY
6095	SOLVING A PROPORTION
6096	CHECKING SOLUTIONS IN VERBAL PROBLEMS - REJECT MEANINGLESS ANSWERS
6097	ESTIMATING RESULT IN A PROBLEM
6098	CHANGING STATEMENT FROM ALGEBRAIC EQUATIONS INTO WORDS
6099	GRAPHING A LINEAR EQUATION IN TWO VARIABLES
6100	GRAPHING A POINT
6101	COMPARING SLOPES TO DETERMINE COLLINEARITY
6102	GRAPHING A LINEAR INEQUALITY IN TWO VARIABLES
6103	GRAPHING THE SOLUTION SET OF A LINEAR INEQUALITY IN ONE VARIABLE
6104	SOLVING INEQUALITIES

CATALOG OF THE APPERCEPTIVE BASE RELATIVE TO TRIGONOMETRY

GENERAL CODE: 7000 - DEFINITION

CATALOG NUMBER	DESCRIPTOR
	FUNCTIONS OF ACUTE ANGLE:
7001	SINE OF ANGLE IN RIGHT TRIANGLE
7002	COSINE OF ANGLE IN RIGHT TRIANGLE
7003	TANGENT OF ANGLE IN RIGHT TRIANGLE

CATALOG OF THE APPERCEPTIVE BASE RELATIVE TO TRIGONOMETRY

GENERAL CODE: 7600 - SKILL

	USE OF TABLE:
7601	TABLE VALUE: SINE
7602	TABLE VALUE: COSINE
7603	TABLE VALUE: TANGENT
	PROBLEM SOLVING TECHNIQUE:
7604	PROBLEM INVOLVING: SINE
7605	PROBLEM INVOLVING: COSINE
7606	PROBLEM INVOLVING: TANGENT
	REVERSE USE OF TABLE:
7607	FIND ANGLE, GIVEN SINE
7608	FIND ANGLE, GIVEN COSINE
7609	FIND ANGLE, GIVEN TANGENT

CONCEPT CATALOG

CATALOG OF THE APPERCEPTIVE BASE: RELATIVE TO GEOMETRY

CODE: 8000 : DEFINITIONS

CATALOG NUMBER	DESCRIPTION
UNDEFINED TERMS:	
8001	GEOMETRIC FIGURE
8002	SHAPE
8003	POINT
8004	LINE
8005	PLANE
8006	SOLID
8007	DISTANCE
8008	LENGTH
8009	WIDTH
8010	HEIGHT
8011	ANGLE
8012	ROTATION
8013	UNIT OF MEASURE
8014	EQUALITY
DEFINED TERMS:	
8015	PERIMETER: UNITS
8016	AREA: UNITS
8017	VOLUME: UNITS
8018	DIAGONAL
8019	CENTER
8020	RADIUS
8021	DIAMETER
8022	CIRCUMFERENCE
8023	ARC
8024	SEMICIRCLE
8025	QUADRANT
8026	SIDE OF ANGLE
8027	VERTEX OF ANGLE
8028	ACUTE ANGLE
8029	RIGHT ANGLE
8030	OBTUSE ANGLE
8031	STRAIGHT ANGLE
8032	REFLEX ANGLE
8033	CENTRAL ANGLE IN CIRCLE
8034	SIDE OF TRAINGLE
8035	VERTEX OF TRIANGLE
8036	BASE OF TRIANGLE
8037	ALTITUDE OF TRIANGLE
8038	EQUIANGULAR TRIANGLE
8039	RIGHT TRIANGLE

CATALOG NUMBER	DESCRIPTOR
8040	ACUTE TRIANGLE
8041	OBTUSE TRIANGLE
8042	EQUILATERAL TRIANGLE
8043	ISOSCELES TRIANGLE
8044	SCALENE TRIANGLE
8045	PARALLEL LINES
8046	PARALLELOGRAM
8047	OPPOSITE SIDES OF PARALLELOGRAM
8048	FACES OF CUBE
8049	EDGES OF CUBE
8050	RADIUS OF A SPHERE
8051	DIAMETER OF A SPHERE
8052	MEASUREMENT
8053	BISECTION
8054	PERPENDICULAR
8055	CONGRUENCE
8056	SIMILARITY
8057	SYMMETRY
8058	STRAIGHT EDGE
8059	SCALE DRAWING
8060	CONSTRUCTION
8061	RECTANGLE
8062	SQUARE
8063	TRAPEZOID
8064	CUBE
8065	CIRCLE
8066	SPHERE
8067	PRISM
8068	RIGHT CIRCULAR CYLINDER
8069	RECTANGULAR SOLID
8070	COMPLEMENTARY ANGLES
8071	SUPPLEMENTARY ANGLES
8072	CONGRUENT TRIANGLES
8073	SIMILAR TRIANGLES
8074	INTERSECTION
8075	TRIANGLE
8076	HYPOTENUSE OF A RIGHT ANGLE
8077	LEG OF RIGHT TRIANGLE
8078	LINE SEGMENT
8079	OPPOSITE SIDES AND ANGLES
8080	VERTICAL ANGLES
8081	ANGLE OF ELEVATION
8082	ANGLE OF DEPRESSION
8083	HORIZONTAL LINE
8084	VERTICAL LINE

CATALOG OF THE APPERCEPTIVE BASE: RELATIVE TO GEOMETRY

GENERAL CODE: 9000 - THEOREMS

9001 AREA OF A RECTANGLE = LENGTH x WIDTH

9002 PERIMETER OF RECTANGLE = THE SUM OF THE SIDES: OR (2L + 2W)

9003 VOLUME OF RECTANGULAR SOLID = LENGTH x WIDTH x HEIGHT

9004 AREA OF SQUARE = SIDE SQUARED = S^2

9005 PERIMETER OF SQUARE = 4S

9006 VOLUME OF A CUBE = SIDE CUBED = S^3

9007 TOTAL SURFACE AREA OF A CUBE = $6S^2$

9008 DIAMETER OF CIRCLE = 2 x RADIUS

9009 RADIUS OF CIRCLE = 1/2 DIAMETER

9010 IN EQUAL CIRCLES, EQUAL ARCS HAVE EQUAL CENTRAL ANGLES

9011 ALL RIGHT ANGLES ARE EQUAL

9012 ALL STRAIGHT ANGLES ARE EQUAL

9013 THE SUM OF THE ANGLES OF A TRIANGLE IS 180 DEGREES

9014 THE SUM OF TWO SIDES OF A TRIANGLE EXCEEDS THE THIRD SIDE

9015 THE CORRESPONDING ANGLES OF PARALLEL LINES ARE EQUAL

9016 THE ALTERNATE INTERIOR ANGLES OF PARALLEL LINES ARE EQUAL

9017 THE OPPOSITE SIDES OF A PARALLELOGRAM ARE EQUAL

9018 THE OPPOSITE ANGLES OF A PARALLELOGRAM ARE EQUAL

9019 THE ANGLES OF A RECTANGLE ARE 90 DEGREES EACH

9020 THE ANGLES OF A SQUARE ARE 90 DEGREES EACH

9021 AREA OF A PARALLELOGRAM = BASE x HEIGHT

9022 AREA OF A TRIANGLE = 1/2 BASE x HEIGHT

9023 AREA OF A TRAPEZOID = 1/2 x HEIGHT x SUM OF BASES

9024 AREA OF CIRCLE = pi x RADIUS SQUARED

9025 CIRCUMFERENCE OF CIRCLE = 2 x pi x RADIUS

9026 LATERAL AREA OF RT. CIR. CYL. = 2 x pi x RADIUS x HEIGHT

9027 VOLUME OF RT. CIR. CYL. = pi x RADIUS SQUARED x HEIGHT

9028 PYTHAGOREAN THEOREM: IN RT. TRIANGLE: $HYP^2 = (LEG_1)^2 + (LEG_2)^2$

9029 TWO TRIANGLES ARE SIMILAR IF THEY AGREE IN 2 ANGLES

9030 CORRESPONDING SIDES OF SIMILAR TRIANGLES ARE IN PROPORTION

9031 ALL VERTICAL ANGLES ARE EQUAL

PROGRAMMED MATH CONTINUUM

LEVEL ONE

ALGEBRA

MEASURABLE BEHAVIORAL OBJECTIVES

New York Institute of Technology

Old Westbury - New York

MBO LIST

Upon completion of this segment, the student should be able to demonstrate that he knows:

I. SCOPE:

01110 This is a year course in Elementary Algebra.

01111 Homework will be assigned.

01112 Notes must be kept in a NOTEBOOK.

01113 Examinations will be given.

II. FORMAT:

01120 The set of books is called the STUDY GUIDE (SG) .

01121 There are 18 VOLUMES (VOL) in the SG.

01122 Each VOL has 5 SEGMENTS (SEG) .

01123 There are 90 SEGS in the SG.

01124 The pages in the SG are in a SCRAMBLED ORDER.

01125 The SG is in programmed instruction format.

III. STRATEGY:

01130 The READING ASSIGNMENT in the TEXT must be done.

01131 The SUPPLEMENTARY NOTES in the SG must be read.

01132 The READING is checked by a series of QUESTIONS.

01133 The QUESTIONS are not tests.

01134 The important points are highlighted by QUESTIONS.

01135 The QUESTIONS are in MULTIPLE CHOICE form.

01136 The incorrect answer choices are called DISTRACTORS.

01137 Each distractor is referred to a separate page.

01138 The page discussing a distractor is called a REM.

01139 The correct answer is called the ANSWER.

MBO LIST

Upon completion of this segment, the student should be able to demonstrate that he knows:

01140 The Answer is followed by the new next question.

01141 A Question can't be located until the previous question was answered correctly.

01142 Each concept to be learned is called an MBO.

01143 MBO means MEASURABLE BEHAVIORAL OBJECTIVE.

01144 Each MBO is highlighted by a QUESTION.

01145 Each QUESTION relates to an MBO.

IV. MATERIALS:

01150 The basic text is DOLCIANI, MODERN ALGEBRA BOOK I.

01151 The remedial text is DRESSLER, COMP. 9TH YR MATH.

01152 The enrichment text is DODES, ALGEBRA.

01153 A NOTEBOOK must be maintained by the student.

01154 PUNCH CARDS are used to record the answer choice.

01155 A STYLUS must be used with the PUNCH CARD.

01156 THE PROGRAM CONTROL (PC) is a light panel.

01157 An ANSWER MATRIX must be used with the PC.

01158 The PUNCH CARD is inserted in the PC

01159 Each QUESTION is answered on the PUNCH CARD.

01160 The ANSWER MATRIX indicates the next page.

01161 One PUNCH CARD is used for each SEG.

01162 The PUNCH CARD is collected after a SEG.

01163 The PUNCH CARD IS ANALYZED BY a COMPUTER.

MBO LIST

Upon completion of this segment, the student should be able to demonstrate that he knows:

V. TECHNIQUES:

01170	How to punch the required INFORMATION on the CARD.
01171	How to proceed from QUESTION to ANSWER.
01172	How to locate the correct page, if lost.
01173	Guessing should be avoided.
01174	The READING should be completed before answering questions.
01175	The problem should be answered in the NOTEBOOK before punching the CARD.
01176	Care should be taken to avoid mistakes in punching.
01177	The student works independently.
01178	The student works at his own pace.
01179	Under certain conditions the student need not work in a classroom or with a teacher.

VI. UPDATE REVISIONS:

01180	In some installations a latent image mark sense sheet will be substituted for the punch card in using the Study Guide.
01181	The latent image sheet will obviate the need for the Program Control Device. (See 01154 - 01163)
01182	The latent image sheet will function as an answer matrix. (01157, 01160)
01183	All references to Punch Card in the Study Guide will be interpreted to mean latent image mark sense sheet.

MBO LIST

Upon completion of this segment, the student should be able to:

MBO CODE	
01210	...place numbers on the number line in order of their magnitude.
01211	...recognize and apply the principle: the counting numbers are also called natural numbers or whole numbers.
01212	...recognize and apply the principle: a fraction indicates a point on a number line between two whole numbers.
01213	...recognize and apply the principle: every whole number has exactly one corresponding point on a number line.
01214	...recognize and apply the principle: every fraction when reduced to lowest terms has exactly one corresponding point on a number line.
01215	...read the value of a whole number or a fraction from its position on the number line.

MBO LIST

Upon completion of this segment, the student should be able to:

MBO CODE	
01220	...recognize and apply the principle: the meanings of the terms: "between" "inclusive", and "including" in reference to descriptions of segments of the number line, as follows.
01221	recognize and apply the principle: "between" means the end points of the segment are not part of the segment. e.g. the whole numbers between 1 and 5 are 2, 3, and 4 only.
01222	recognize and apply the principle: "inclusive" means the end points of the segment are also part of the segment. e.g. the whole numbers between 1 and 5 inclusive are 1,2,3,4,and 5.
01223	recognize and apply the principle: "including" means only one of the end points of the segment is part of the segment. e.g. the whole numbers between 1 and 5, including 5 are 2,3,4, and 5; the whole numbers between 1 and 5, including 1 are 1,2,3, and 4.
01230	...recognize and apply the principle: the numbers on the number line being considered can be indicated by a darkened line.
01231	recognize and apply the principle: "between" is indicated by 2 open circles connected by darkened line.
01232	recognize and apply the principle: "inclusive" is indicated by 2 filled in circles connected by a darkened line.
01233	recognize and apply the principle: "including" is indicated by an open circle and a filled in circle connected by a darkened line.

MBO LIST

Upon completion of this segment, the student should be able to:

MBO CODE	
01310	...recognize and apply the principle: the equal sign between two quantities indicates that they represent the same number.
01311	...recognize and apply the principle: a number may be written with different symbols called numerals.
01312	...recognize and apply the principle: the operation "+" performed on two numbers gives a number as a result; the result is independent of the order.
01313	...recognize and apply the principle: the operation "-" performed on two numbers gives a number as a result, if the first number is larger than the second.
01314	...recognize that the operation "x" performed on two numbers gives a number as a result; the result is independent of the order.
01315	...recognize that the operation "÷" performed on two numbers gives a number as a result and that the result depends on the order of the numbers; the second number must not be zero.
01320	...recognize that the inequality sign ≠ between two quantities indicates that they represent different numbers.
01321	...recognize that the sign < between two numbers indicates that the first number is smaller than the second.
01322	...recognize that the sign > between two numbers indicates that the first number is larger than the second.
01323	...recognize that for any two numbers given in order, one of the three signs < , = , > can be properly between them.

MBO LIST

Upon completion of this segment, the student should be able to:

MBO CODE	
01330	. . .find a number that will produce two quantities having a given relation as in the following applications:
01331	find a number which can be inserted in an expression so as to produce two quantities which are equal.
01332	find a number which can be inserted in an expression so as to produce two quantities which are unequal.
01333	find a number which can be inserted in an expression so as to produce two quantities where the first is smaller than the second.
01334	find a number which can be inserted in an expression so as to produce two quantities where the first is larger than the second.

MBO LIST

Upon completion of this segment, the student should be able to:

MBO CODE	
01410	...recognize the meaning of "member" or "element" of a set.
01411	...recognize and apply the principle; the symbol $\in$ means "is an element of".
01412	...recognize and apply the principle; that the symbol $\notin$ means "is NOT an element of".
01413	...determine whether an item is an element of a given set.
01414	...determine whether an item is NOT an element of a given set.
01420	...recognize that sets can be written various ways, as follows:
01421	name sets by the roster method.
01422	name sets by the rule method.
01430	...recognize the meanings of "words describing sets" as follows:
01431	determine if two sets are in "1 to 1 correspondence".
01432	recognize and apply the principle: an infinite set contains an unlimited number of elements.
01433	recognize and apply the principle: a finite set contains a limited number of elements.
01434	recognize and apply the principle: the symbol $\emptyset$ represents the empty set.
01435	recognize and apply the principle: the set $\{\emptyset\}$ is NOT an empty set.

MBO LIST

Upon completion of this segment.
the student should be able to:

MBO CODE	
01510	...form subsets of given sets.
01511	...recognize subsets of given sets given a rule in the following applications:
01512	list all subsets of given sets.
01513	recognize and list proper subsets of a set.
01514	recognize an improper subset of a set.
01515	recognize that the null set is a subset of every set except itself.
01520	write sets of which a given set is a proper subset.

MBO LIST

Upon completion of this segment, the student should be able to:

MBO CODE	
02110	...recognize and apply the principle: a pair of parentheses ( ) is a symbol of inclusion.
02111	...use a pair of parentheses to replace the symbol "x" in the operation of multiplication.
02112	...use brackets [ ], braces { }, and a bar ‾‾ for the same purpose as the parentheses, when more than one pair of parentheses would cause confusion.
02120	...recognize and apply the rule: in an expression containing a grouping inside of a grouping, the numeral in the innermost symbol of inclusion is simplified first and this procedure is repeated until all symbols of inclusion are removed.
02130	...recognize and apply the rule for the order of operations.
02131	...recognize and apply the rule: if no symbols of inclusion are present, multiplications and divisions are performed in order, first from left to right.
02132	...recognize and apply the rule: if no symbols of inclusion are present after multiplication and division, any additions and subtractions are performed in order from left to right.

MBO LIST

Upon completion of this segment, the student should be able to:

MBO CODE	
02210	...recognize and apply the meanings of the words describing algebraic expressions as follows:
02211	...recognize and apply the principle: a variable is a symbol that may represent any of the elements of a specified set.
02212	...recognize and apply the principle: a literal number is a letter representing a variable.
02213	...recognize and apply the principle: a constant is a variable with just one value.
02214	...recognize and apply the principle: an expression containing a variable is called a variable expression or an open expression.
02215	...recognize and apply the principle: if a variable is replaced by each element of its replacement set, the expression represents different numbers.
02216	...recognize and apply the principle: a set whose elements serve as replacements for a variable is called the domain of the variable.
02217	...recognize and apply the principle: the domain of the variable can also be called the replacement set.

MBO LIST

Upon completion of this segment, the student should be able to:

MBO CODE	
02220	...evaluate algebraic expressions.
02221	...recognize and apply the principle: the process of determining the number an algebraic expression represents is called evaluating the expression or finding its value.
02222	...recognize that an algebraic expression written as a product or quotient of numerals or variables or both is called a term.
02223	...recognize and apply the principle: a product containing a variable may be written without the "x" (multiplication sign) indicating multiplication, e.g. $3n = 3 \times n$, $ab = a \times b$.
02224	...recognize and apply the principle: that a dot, " . " may be used to show multiplication, e.g. $2 \cdot n = 2 \times n$, $8 \cdot 7 = 8 \times 7$
02225	...evaluate algebraic expressions by performing the operation: "x"
02226	...evaluate algebraic expressions by performing the operation: "÷".
02227	...evaluate algebraic expressions by performing the operation: " + ".
02228	...evaluate algebraic expressions by performing the operation: " - ".

MBO LIST

Upon completion of this segment, the student should be able to:

MBO CODE	
02310	...name the factors of a given term.
02311	...recognize and apply the principle: if two or more numbers are multiplied, each of the numbers is called a factor of the product.
02312	...recognize and apply the principle: in factoring whole numbers, only whole number factors are considered.
02313	...recognize and apply the principle: the number, +1, is a factor of all whole numbers.
02314	...recognize and apply the principle: any number is a factor of itself.
02320	...name the coefficients of a given term.
02321	...recognize and apply the principle: each factor of a product is the coefficient of the product of the other factors.
02322	...recognize and apply the principle: the numerical factor of a term is also called the coefficient of the term.
02323	...recognize and apply the principle: the number, +1, is a coefficient of any term.
02324	...recognize that the number, +1, is a coefficient of every literal number.

MBO LIST

Upon completion of this segment, the student should be able to:

MBO CODE	
02330	...name exponents and bases of given terms as follows:
02331	recognize and apply the principle: an exponent of a term is a symbol that tells how many times that term is to used as a factor.
02332	recognize and apply the principle: a term with an exponent is called a base.
02340	...evaluate expressions in the following cases:
02341	evaluate expressions containing variable factors.
02342	evaluate expressions containing coefficients and variables.
02343	evaluate expressions containing variables and exponents.
02344	evaluate expressions containing coefficients, variables, and exponents.

MBO LIST

Upon completion of this segment, the student should be able to:

MBO CODE	
02410	...solve open algebraic sentences.
02411	...recognize and apply the principle: an algebraic sentence is a statement composed of algebraic expressions related by symbols: $=$, $\neq$, $>$, $<$, $\geq$, and $\leq$
02412	recognize and apply the principle: a sentence containing a variable is called an open sentence.
02413	...recognize and apply the principle: an open sentence may be neither true nor false, if the values of the variables are left open.
02414	...recognize and apply the principle: the subset of the domain of the variable which makes the open sentence true is called the solution set of the open sentence.
02420	...recognize and apply the principle: an open sentence using the symbol $=$ is an equation.
02421	...determine the solution set of an equation by substituting elements from the domain of the variable.
02430	...recognize and apply the principle: an open algebraic sentence not using "=" is called an inequality.
02431	...determine the solution set of an inequality by substituting elements from the domain of the variable.

MBO LIST

MBO CODE	
02510	...interpret an algebraic expression as a verbal mathematical relationship.
02511	...determine the conditions under which an interpretation of an algebraic expression has meaning or no meaning.
02512	...recognize and apply the principle: giving a concrete translation to an algebraic expression means that the expression cannot be such as to make the variable equal to zero. e.g. if x is the width of a rectangle and $2x - 3$ is the length then x must be greater than $\frac{3}{2}$
02520	...translate a verbal mathematical relationship into an algebraic expression:
02521	...recognize and apply the principle: the word "represents" can be interpreted as " = "
02522	...recognize and apply the principle: the phrase " a is k more than b " can be written in the three following ways: (1) $a = k + b$ (2) $a - b = k$ (3) $a - k = b$

MBO LIST

MBO CODE	
02523	...recognize and apply the principle: the phrase " a is k less than b " can be written in the three following ways: (1) $a = b - k$ (2) $a + k = b$ (3) $k = b - a$
02524	...recognize and apply the principle: the phrase " the difference between a and b is k " can be written $a - b = k$
02525	...recognize and apply the principle: the phrase " a certain fraction of " indicates multiplication by the fraction e.g. "two-thirds of twelve" is written $\frac{2}{3} \times 12$
02526	...recognize and apply the principle: the phrase "the product of a and b" is written: $a \times b$, or ab.
02527	...recognize and apply the principle: the phrase "the quotient of a and b" is written: $\frac{a}{b}$

MBO-LIST

Upon completion of this segment, the student should be able to:

MBO CODE	
03110	...write an open sentence of the first degree to fit a verbally posed problem using the following sequence of operations:
03111	recognize and apply the principle: a symbol can be designated to replace an unknown quantity.
03112	apply the operations of arithmetic to symbols so as to translate verbal phrases into mathematical sentences.
03113	solve an open sentence of the first degree.
03114	recognize and apply the principle: the conditions of the problem limit the domain of the replacement set of the open sentence.
03115	find those elements of the domain of the variable that produce a true statement for the open sentence.
03116	check the members of the proposed solution set with the words of the problem for meaning.

MBO LIST

Upon completion of this segment, the student should be able to:

MBO CODE	
03210	...recognize and apply the mathematical properties of equality, as follows:
03211	recognize and apply the Reflexive Property of equality, i.e. for any number x , $x = x$.
03212	recognize and apply the Symmetric Property of equality, i.e. for any numbers a and b , if $a = b$ then $b = a$.
03213	recognize and apply the Transitive Property of equality, i.e. for any numbers a , b , and c ; if $a = b$ and $b = c$ then $a = c$.
03220	...recognize and apply the meanings of the Closure Properties of sets under operations, as follows:
03221	recognize and apply the principle: for every element a and for every element b which are members of set S , then $(a + b)$ is a unique number which is also a member of set S .
03222	recognize and apply the principle: for every element a and for every element b which are members of set S where $a > b$, the difference $a - b$ is a unique number which is a member of set S .

MBO LIST

Upon completion of this segment, the student should be able to:

MBO CODE	
03223	recognize and apply the principle: for every element a and every element b which are members of set S , the product ab is a unique number which is a member of set S .
03224	recognize and apply the principle: for every element a and every element b which are members of set S , and b is a number other than zero, the quotient of a and b written $\frac{a}{b}$ is a unique number which is a member of set S.
03230	...recognize and apply the meaning of open set in the following applications:
03231	recognize and apply the principle: if in set S the sum of a + b is NOT a member of the set, the set is said to be "open" with respect to addition.
03232	recognize and apply the principle: if in set S the difference of a and b , is NOT a member of the set, the set is said to be "open" with respect to subtraction.
03233	recognize and apply the principle: if in set S the product ab is NOT a member of the set, the set is said to be "open" with respect to multiplication
03234	recognize and apply the principle: if in set S the quotient $\frac{a}{b}$ is NOT a member of the set, the set is said to be "open" with respect to division.
03340	...recognize and apply the meaning of the Substitution Principle: for any numbers a and b , if a = b then a and b may be substituted for each other in an expression without changing the value of the expression.

MBO LIST

Upon completion of this segment, the student should be able to:

MBO CODE	
03310	...recognize and apply the commutative properties of operations as follows:
03311	recognize and apply the Commutative Property of Addition: for every number a and every number b , $a + b = b + a$
03312	recognize and apply the Commutative Property of Multiplication: for every number a and every number b , $a \cdot b = b \cdot a$
03313	recognize and apply the principle: for every number a and every number b , if $a \neq b$, then $a - b \neq b - a$.
03314	recognize and apply the principle: for every number a and every number b , if $a \neq 0$, and if $b \neq 0$, and $a \neq b$, then $\frac{a}{b} \neq \frac{b}{a}$
03320	...recognize and apply the Associative Properties of operations as follows:
03321	recognize and apply the Associative Property of Addition for every number a , every number b and every number c , $a + (b + c) = (a + b) + c$
03322	recognize and Apply the Associative Property of Multiplication for every number a , every number b , and every number c , $a \cdot (b \cdot c) = (a \cdot b) \cdot c$.
03323	recognize and apply the principle: for every number a , every number b , and every number c , where $b \neq 0$, $c \neq 0$, $a - (b - c) \neq (a - b) - c$.
03324	recognize and apply the principle: for every number a , every number b , and every number c , where $a \neq 0$, $b \neq 0$, $c \neq 0$ & $a \neq b \neq c$; $\frac{\frac{a}{b}}{c} \neq \frac{\frac{a}{b}}{c}$

MBO LIST

Upon completion of this segment, the student should be able to:

MBO CODE	
03330	...recognize and apply the Distributive Property to operations as follows:
03331	recognize and apply the principle: for every number a , every number b , every number c , $a(b + c) = ab + ac$
03332	recognize and apply the principle: for every number a , every number b , every number c , for which $b - c$ is a number, $a(b - c) = ab - ac$
03333	recognize and apply the principle: for every number a , every number b , every number c , $a(b \cdot c) \neq ab \cdot ac$; $a, b, c \neq 0$
03334	recognize and apply the principle: for every number a , every number b , every number c , (except $c = 0$) $\frac{(a + b)}{c} = \frac{a}{c} + \frac{b}{c}$
03335	recognize and apply the principle: for every number a , every number b , every number c , (except $c = 0$) $\frac{(a - b)}{c} = \frac{a}{c} - \frac{b}{c}$
03336	recognize and apply the principle: for every number a , every number b , every number c , where $a, b, c \neq 0$ $\frac{\frac{a}{b}}{c} \neq \frac{\frac{a}{c}}{\frac{b}{c}}$
03340	...recognize and apply the Principles of Identity in multiplication and addition as follows:
03341	recognize that for every a, $(1 \cdot a = a \cdot 1 = a)$
03342	recognize that for every a, $(0 + a = a + 0 = a)$
03343	recognize that for every a, $(0 \cdot a = a \cdot 0 = 0)$

MBO LISI

Upon completion of this segment, the student should be able to:

MBO CODE	
03410	...recognize and apply the Addition and Subtraction Properties of Equality as follows:
03411	recognize and apply the principle: for each a , each b , and each c , if $a = b$ then $a + c = b + c$.
03412	recognize and apply the principle: for each a , each b , each c , for which $a - c$ is a number, then if $a = b$, $a - c = b - c$.
03420	...solve simple linear equations using the Addition Property and the following sequence of operations:
03421	recognize and apply the principle: addition and subtraction are inverse operations.
03422	if the equation is of the form $x - a = b$, choose the addition inverse of ($-a$) , i.e. ($+a$)
03423	apply the Addition Property i.e. add $+a$ to both sides of the equation. $x - a + a = b + a$ $x = b + a$
03430	...solve simple linear equations using the Subtraction Property and the following sequence of operations:
03431	if the equation is of the form: $x + a = b$, choose the additive inverse of ($+a$) , i.e. ($-a$)
03432	apply the Subtraction Property i.e. subtract from both sides of the equation. $x + a - a = b - a$ $x = b - a$
03440	...apply the solution of simple linear equations using the Addition and Subtraction Properties of Equality to Verbal Problems.

MBO LIST

Upon completion of this segment, the student should be able to:

MBO CODE	
03510	...recognize and apply the Division and Multiplication Properties of Equality.
03511	...recognize and apply the principle: for each a, each b, and each non-zero c, if $a = b$, then $\frac{a}{c} = \frac{b}{c}$
03512	...recognize and apply the principle: for each a, each b, and each c, if $a = b$, then $ac = bc$
03520	...recognize and apply the principle: division and multiplication are inverse operations.
03521	...solve simple equations of the form $ax = b$ using the Division Property, as follows: $\frac{ax}{a} = \frac{b}{a}$ $x = \frac{b}{a}$
03522	...solve simple equations of the form $\frac{x}{a} = b$ using the Multiplication Property, as follows: $a \cdot \frac{x}{a} = b \cdot a$ $x = ab$
03530	...apply the Division and Multiplication Properties of Equality to the solution of simple equations in Verbal Problems.

MBO LIST

Upon completion of this segment, the student should be able to:

MBO CODE	
04110	...combine similar terms.
04111	...recognize and apply the principle: similar terms are numerical terms or variable terms whose variable factors are the same, e.g. 7 and 9 are similar 3x and 5x are similar
04112	...recognize and apply the principle: unlike terms are variable terms whose variable factors are different, e.g. 3x and $3y_2$ are unlike terms. 3x and $3x^2$ are unlike terms
04120	...solve equations with similar terms on only one side of the equation using the following sequence of operations:
04121	combine similar terms
04122	choose appropriate axiom of equality to isolate the unknown on one side of the equation
04123	check the solution by substitution in the original equation
04130	...apply principles of combining similar terms to verbal problems.

MBO LIST

Upon completion of this segment, the student should be able to:

MBO CODE	
04210	...solve equations with similar terms on both sides of the equation, using the following sequence of operations:
04211	combine similar terms
04212	recognize and apply the appropriate additive inverse to isolate the variable on one side of the equation and use the additive axiom.
04213	recognize and apply the appropriate additive inverse to isolate the numerical terms on the other side of the equation and use the addition axiom.
04214	recognize and apply the appropriate multiplicative inverse to make the coefficient of the unknown unity and apply the multiplication axiom.
04215	check the solution in the original equation.
04220	...apply principles of combining similar terms on both sides of an equation to verbal problems.

MBO LIST

Upon completion of this segment, the student should be able to:

MBO CODE	
04310	...recognize that the number line may be extended in both directions, left and right.
04311	...recognize and apply the principle: The symbols of operation, + and - are also symbols of direction when applied to a number line.
04312	...recognize and apply the principle: the symbol of direction, +, indicates a point to the right of zero.
04313	...recognize and apply the principle: the symbol of direction, -, indicates a point to the left of zero.

MBO LIST

Upon completion of this segment, the student should be able to:

MBO CODE	
04310	...recognize that the number line may be extended in both directions, left and right.
04311	...recognize and apply the principle: the symbols of operation, + and - are also symbols of direction when applied to a number line.
04312	...recognize and apply the principle: the symbol of direction, + , indicates a point to the right of zero.
04313	...recognize and apply the principle: the symbol of direction, - , indicates a point to the left of zero.
04320	...recognize and apply the principle: numbers whose numerals involve symbols of direction are called directed or signed numbers.
04321	...recognize and apply the principle: the distance between a number and zero is called the magnitude of that number.
04322	...recognize and apply the principle: a number preceded by the symbol of direction, + , is called a positive number.
04323	...recognize and apply the principle: a number preceded by the symbol of direction, - , is called a negative number.
04324	...recognize and apply the principle: the opposite of a positive number is a negative number with the same magnitude.
04330	...recognize and apply the principle: directed numbers are ordered.
04331	...recognize and apply the principle: the direction "left of", on a number line and the phrase "less than" when applied to numbers are equivalent.
04332	...recognize and apply the principle: the direction"right of", on a number line, and the phrase "more than" when applied to numbers are equivalent.

MBO LIST

Upon completion of this segment, the student should be able to:

MBO CODE	
04410	...add numbers on a number line.
04411	...recognize and apply the principle: addition on a number line can be considered in terms of a change in position on the line.
04412	...recognize and apply the principle: that adding a number preceded by the symbol of direction, +, results in a move to the right.
04413	...recognize and apply the principle: adding a number preceded by the symbol of direction, -, results in a move to the left.
04420	...recognize the physical application on a number line of the identity property of addition.
04421	...recognize and apply the principle: adding numbers of the same magnitude but opposite symbols of direction results in a final position of zero.
04422	...recognize and apply the principle: adding zero to a number results in no change of position on the number line.

MBO LIST

Upon completion of this segment, the student should be able to:

MBO CODE	
04510	...recogn[illegible] and apply the principle: that fo[illegible]ry directed number, "a", there is a unique number "-a" called the additive inverse such that $a + (-a) = (-a) + a = 0$.
04511	...recognize that the additive inverse of the sum of two numbers is the sum of their additive inverses. $-(a + b) = (-a) + (-b)$
04512	...recognize that a number preceded by a negative sign, e.g. -b, may mean either negative b or the opposite of b .
04520	...recognize and apply the meaning of absolute value and its symbol
04521	...recognize that if $a > 0$, $\|a\| = a$
04522	...recognize that if $a < 0$, $\|a\| = -a$
04523	...recognize and apply the principle: the absolute values of a number and that of its opposite are equal.
04530	...evaluate expressions containing absolute value symbols.
04531	...write solution sets of open sentences containing absolute value symbols.

MBO LIST

Upon completion of this segment, the student should be able to:

MBO CODE	
05110	...recognize and apply rules for addition of directed numbers without reference to the number line.
05111	...recognize and apply the principle: for any two numbers, a and b, if $a \geq 0$ and $b \geq 0$ then $a + b = \lvert a \rvert + \lvert b \rvert$
05112	...recognize and apply the principle: for any two numbers, a and b, if $a < 0$ and $b < 0$ then $a + b = -(\lvert a \rvert + \lvert b \rvert)$
05113	...recognize and apply the principle: that for any two numbers, a and b, if $a > 0$ and $b < 0$ and $\lvert a \rvert \geq \lvert b \rvert$ then $a + b = +(\lvert a \rvert - \lvert b \rvert)$
05114	...recognize and apply the principle: for any two numbers, a and b, if $a > 0$ and $b < 0$ and $\lvert b \rvert \geq \lvert a \rvert$ then $a + b = -(\lvert b \rvert - \lvert a \rvert)$
05120	recognize and apply rules for subtraction of directed numbers without reference to the number line.
05121	...recognize and apply the principle: for any two numbers, a and b, the difference of a and b, $a - b$, equals $a + (-b)$

MBO LIST

Upon completion of this segment, the student should be able to:

MBO CODE	
05210	...recognize and apply the rules for multiplication of directed numbers as follows:
05211	for any "a", $a(-1) = (-1)a = -a$
05212	the absolute value of the product of two directed numbers is the product of their absolute values. i.e. $\lvert ab \rvert = \lvert a \rvert \cdot \lvert b \rvert$
05213	the product of two positive numbers is a positive number. e.g. $(+a) \cdot (+b) = +ab$
05214	the product of two negative numbers is a positive number. e.g. $(-a) \cdot (-b) = (-b) \cdot (-a) = +ab$
05215	the product of a positive number and a negative number is a negative number. e.g. $(-a) \cdot (b) = (a) \cdot (-b) = -(ab)$
05216	an indicated product containing an odd number of negative factors is a negative number.
05217	an indicated product containing an even number of negative factors is a positive number.

MBO LIST

Upon completion of this segment, the student should be able to:

MBO CODE

05310 ...recognize and apply the principle of division to directed numbers, as follows:

05311 ...recognize and apply the principle: for all directed numbers a and b, the directed number, x, satisfying the equation $bx = a$, where $b \neq 0$, is called the quotient of a and b and is written as

$$x = a \div b \text{ or } x = \frac{a}{b}$$

05312 ...recognize and apply the principle: the operation division can be performed by multiplying the dividend by the reciprocal of the divisor.

$$a \div b = a \cdot \frac{1}{b}$$

05313 ...recognize and apply the principle: the absolute value of the quotient of two directed numbers is the quotient of the absolute values of the numbers.

i.e. $\left|\frac{a}{b}\right| = \frac{|a|}{|b|}$

05314 ...recognize and apply the principle: the quotient of a positive and negative number is a negative number.

i.e. $\frac{+a}{-b} = -\frac{a}{b}$

$$\frac{-a}{+b} = -\frac{a}{b}$$

05315 ...recognize and apply the principle: the quotient of two positive numbers is

i.e. $\frac{+a}{+b} = +\frac{a}{b}$

MBO LIST

Upon completion of this segment, the student should be able to:

MBO CODE

05316 ...recognize and apply the principle: the quotient of two negative numbers is a positive number.

i.e. $\frac{-a}{-b} = +\frac{a}{b}$

05317 ...recognize and apply the principle: for every directed number a, other than zero, there is a unique number, denoted by $\frac{1}{a}$, called the reciprocal such that

$a \cdot \frac{1}{a} = \frac{1}{a} \cdot a = 1$

05318 ...recognize that the reciprocal of a product of two numbers, each not = 0, is the product of the reciprocals of the number.

i.e. $\frac{1}{ab} = \frac{1}{a} \cdot \frac{1}{b}$

05319 ...recognize and apply the principle: the sign of the reciprocal of a number is the same as the sign of the number.

i.e. the reciprocal of $-a$ is $-\frac{1}{a}$

the reciprocal of $+a$ is $+\frac{1}{a}$

MBO LIST

Upon completion of this segment, the student should be able to:

MBO CODE	
05410	...apply the axioms of addition and subtraction to equations in the set of directed numbers.
05411	...recognize and apply the principle: an equation or open sentence states that two quantities are = .
05412	...recognize and apply the principle: the same directed number may be added to the value of each member of any equation without changing the solution set of the equation.
05413	...recognize and apply the principle: the same directed number may be subtracted from the value of each member of an equation without changing the solution set of the equation.
05420	...apply the axioms of multiplication and division to equations having solutions in the set of directed numbers.
05421	...recognize and apply the principle: each member of an equation may be multiplied by the same non-zero number without changing the solution set.
05422	...recognize and apply the principle: each member of an equation may be divided by the same non-zero number without changing the solution set.
05430	...apply the axioms to transform literal equations in terms of specified variable.
05431	...solve literal equations for one variable using the addition axiom.
05432	...solve literal equations for one variable using the subtraction axiom.
05433	...solve literal equations for one variable using the multiplication axiom.
05434	...solve literal equations for one variable using the division axiom.

MBO LIST

Upon completion of this segment, the student should be able to:

MBO CODE

05510 ...recognize and apply the properties of the inequality relation, as follows:

05511 recognize and apply the principle: for each pair of directed numbers a and b, one and only one of the following statements is true: $a < b$, $a = b$, $a > b$.

05512 recognize and apply the principle: the inequality relationship has the transitive property, i.e. for any directed numbers a, b, and c:
if $a < b$ and $b < c$ then $a < c$

if $a > b$ and $b > c$ then $a > c$

05520 ...recognize and apply the properties of operations to inequality relationships of any directed numbers, a, b and c, as follows:

05521 if $a < b$ then $a + c < b + c$
if $a > b$ then $a + c > b + c$

05522 if $a < b$ then $a - c < b - c$
if $a > b$ then $a - c > b - c$

05523 if $a < b$ then $ac < bc$ when $c > 0$

05524 if $a < b$ then $ac = bc$ when $c = 0$

05525 if $a < b$ then $ac > bc$ when $c < 0$

05526 if $a < b$ then $\frac{a}{c} < \frac{b}{c}$ when $c > 0$

05527 if $a < b$ then $\frac{a}{c} > \frac{b}{c}$ when $c < 0$

05530 ...recognize and apply the principle: inequalities have solution sets.

05531 ...find the solution set of an inequality by transforming it into an equivalent inequality.
e.g. the solution set of $7x - 13 < 3x - 1$ is found by transforming it into the equivalent equality, $x < 3$

MBO LIST

Upon completion of this segment, the student should be able to:

MBO CODE	
06110	...solve an open sentence of the first degree, chosen to fit a verbally posed problem.
06111	...designate a variable to represent the one unknown in the problem.
06112	...write an open sentence of the first degree to fit a verbally posed problem.
06113	...apply the operation of arithmetic to symbols and constants so as to translate verbal phrases into mathematical sentences.
06114	...find those elements of the domain of the variable that produce a true statement for the sentence.
06115	...check the members of the proposed solution set with the words of the problem.
06120	...solve an open sentence of the first degree concerned with consecutive integers.
06121	...recognize that an integer is a whole number and may be $= 0$.
06122	...recognize that two consecutive integers differ by one.
06123	...recognize that if x is an integer, $x + 1$ is the next consecutive larger integer.
06124	...recognize that if x is an integer, $x - 1$ is the next consecutive smaller integer.
06125	...recognize that if x is an even integer, $x + 2$ is the next consecutive even integer.
06126	...recognize that if x is an odd integer, $x + 2$ is the next consecutive odd integer.

MBO LIST

Upon completion of this segment, the student should be able to:

MBO CODE	
06210	...write open sentences dealing with angles applying the following principle:
06211	recognize and apply the principle: a ray is a straight line having a definite starting point but an indefinite end point.
06212	recognize and apply the principle: an angle is formed by the rotation of one ray about another.
06213	recognize and apply the principle: the size of an angle depends upon the amount of rotation.
06214	recognize and apply the principle: a full rotation is assigned a value of 360 degrees.
06215	recognize and apply the principle: one degree represents $\frac{1}{360}$ of a rotation; that 90 degrees represents $\frac{1}{4}$ of a rotation; and that 180 degrees represents $\frac{1}{2}$ of a rotation.
06216	recognize and apply the principle: if the sum of the measures of two angles is 90 degrees, then those angles are said to be COMPLEMENTARY.
06217	recognize and apply the principle: if the sum of the measures of two angles is 180 degrees, then those angles are said to be SUPPLEMENTARY.
06218	recognize and apply the principle: the sum of the angles of a triangle is 180 degrees.
06220	...solve open sentences of the first degree dealing with angles.
06221	...check first degree open sentences dealing with angles.
06222	...substitute values for variables in particular open sentences dealing with angles.
06223	...draw a diagram representing algebraic relationships involving angles.

MBO LIST

Upon completion of this segment, the student should be able to:

MBO LIST	
06310	...solve open sentences of the first degree in one unknown dealing with uniform motion using the following sequence of operations:
06311	recognize and apply the principle: distance equals the product of rate and time.
06312	sketch a rough drawing corresponding to the data of the problem.
06313	arrange the facts of the problem in chart form.
06314	write the particular open sentence from the data.
06315	apply the Properties of Equality to solve the open sentence.
06316	specify the solution set of the open sentence.
06317	check the solution by substituting the values found for the variables in the original verbal problem.

MBO LIST

Upon completion of this segment, the student should be able to:

MBO CODE	
06410	...solve open sentences of the first degree in one unknown dealing with mixtures, using the following sequence of operations:
06411	recognize and apply the principle: the product of the amount of a quantity and its unit cost is the total cost of the quantity.
06412	recognize that the product of the amount of a quantity and its percentage of a pure substance is the amount of the pure substance.
06413	recognize that the sum of the values or unit weights of the original ingredients must equal the value or weight of the final mixture.
06414	arrange the facts of the problem in chart form.
06415	write the particular open sentence from the data.
06416	apply the Properties of Equality to solve the open sentence.
06417	specify the solution set of the open sentence.
06418	check the solution set by substituting the values found for the variables in the original verbal problem.

MBO LIST

Upon completion of this segment, the student should be able to:

MBO CODE	
06510	...recognize and apply various words dealing with polynomials as follows:
06511	recognize and apply the principle: a polynomial is an indicated sum of monomials or a monomial itself.
06512	recognize and apply the principle: a polynomial of 2 terms is called a binomial.
06513	recognize and apply the principle: a polynomial of 3 terms is called a trinomial.
06514	recognize and apply the principle: polynomials can be classified according to the degree of some monomials in a particular variable.
06515	recognize and apply the principle: the degree of a monomial is the sum of the degrees in each of its variables.
06516	recognize and apply the principle: the degree of a polynomial is the same as the greatest of the degrees of the monomials that compose it.

MBO LIST

Upon completion of this segment, the student should be able to:

MBO CODE	
06520	...add polynomials.
06521	...recognize and apply the principle: polynomials should be arranged with the terms in the order of decreasing degree or increasing degree in a particular variable.
06522	...recognize and apply the principle: the Commutative, Associative and Distributive properties apply to addition of polynomials.
06523	...recognize and apply the principle: polynomials are added by combining their similar terms, if any.
06530	...subtract polynomials.
06531	...recognize and apply the principle: subtracting a term is the same as adding the additive inverse of that particular term.
06532	...recognize and apply the principle: subtracting a polynomial is the same as adding the additive inverse of each term of the polynomial.
06533	...recognize and apply the principle: symbols of inclusion may appear in an expression to indicate the addition or subtraction of a polynomial.
06540	...solve equations involving addition and subtraction of polynomials.

MBO LIST

Upon completion of this segment, the student should be able to:

MBO CODE

07110 ...recognize and apply the principle for multiplication of powers having the same base

$$b^a + b^c = b^{a+c}$$

07111 ...recognize the meaning of the words
power: a number expressed in the form:

$$b^n = \overbrace{b \cdot b \ldots b}^{n \text{ factors}}$$

base: the number b
exponent: the number n

07113 ...recognize and apply the principle: the exponent applies only to the numeral next to which it is written.

e.g. ab^2 means a^1b^c

07114 ...multiply powers having the same one letter base and numerical exponent.

e.g. $b^2 b^3 = b^5$

07115 ...multiply powers having more than one letter base and numerical exponents.

$$(a^2b^3) \cdot (a^5b^4) = a^7b^7$$

MBO LIST

Upon completion of this segment the student should be able to:

MBO CODE

07116 ...multiply powers having numerical coefficients and literal bases with numerical exponents.

e.g. $(4a^2b^4)\quad(7ab^3) = 28a^3b^7$

07117 ...multiply powers with the same letter base.

$$x^a \; x^b = x^{a+b}$$

$$x^{na} \; x^{ma} = x^{(n+n)\,a}$$

07120 ...calculate powers of the product of quantities.

07121 ...recognize and apply the principle: a power raised to an exponent is a product of powers.

$$(b^n)^m = \overbrace{b^n \cdot b^n \ldots b^n}^{m \text{ factors}}$$

MBO LIST

Upon the completion of this segment, the student should be able to:

MBO CODE

07122 ...recognize and apply the principle: a product raised to a power, raises each factor to that power.

$$(ab)^n = a^n b^n$$

07123 ...calculate a power raised to a literal power.

$$(b^m)^n = b^{mn}$$

07124 ...calculate a negative quantity raised to an add power.

$(-b)^n$ (where n is odd) $= -b^n$

07125 ...calculate a negative quantity raised to an even power.

$(-b)^n$ (where n is even) $= +b^n$

07126 ...recognize and apply the principle: each letter in the base of a term raised to a power is equal to the product of the letters raised to that power.

$$a^n b^n = (ab)^n$$

MBO LIST

Upon completion of this segment, the student should be able to:

MBO CODE	
07210	...multiply a polynomial by a monomial.
07211	...recognize a polynomial in one variable, $ax^2 + bx + c$
07212	...recognize a polynomial in more than one variable, $ax^2 + bxy + cy^2$
07213	...recognize the words: monomial - is a polynomial with one term binomial - is a polynomial with two terms trinomial - is a polynomial with three terms
07214	...calculate, using the distributive law, the product $a(b + c) = ab + ac$
07215	...multiply a polynomial by a positive number, e.g. $3(a^2 + 2ab) = 3a^2 + 6ab$
07216	...multiply a polynomial by a negative number, e.g. $-7(a^2 - 4c^2) = -7a^2 + 28c^2$
07217	...multiply a polynomial by a monomial containing letters raised to powers, e.g. $5r^2s^2(2r^2 - 3s^2 + 6rs) = 10r^4s^2 - 15r^2s^4 + 30r^3s^3$
07218	...combine like terms in the sum of the products resulting from the multiplication of a polynomial by a monomial, e.g. $3(x - y) + 3(y - z) + 5(z - x) = 3x - 3y + 3y - 3z + 5z - 5x = -2x + 2z$

MBO LIST

Upon completion of this segment, the student should be able to:

MBO CODE	
07310	...multiply a polynomial by a polynomial.
07311	...recognize ascending powers of a variable in a polynomial. e.g. $a + bx + cx^2 + dx^3 \ldots$
07312	...recognize descending powers of a variable in a polynomial. e.g. $ax^3 + bx^2 + cx + d$
07313	...arrange a polynomial in ascending or descending powers of a variable, e.g. arrange $3x^2y + 7y^3 + 6x^3 - xy^2 + 5$ in descending powers of x $6x^3 + 3x^2y - xy^2 + 7y^3 + 5$
07314	...recognize and apply the principle: a binomial may be treated as a single term when multiplying another binomial in applying the Distributive Law e.g. $(4x + 5)(3x + 2) = (4x + 5)(3x) + (4x + 5)(2)$
07315	...calculate the product of 2 binomials in vertical form, e.g. $3x + 5$ $\underline{2x + 4}$ $6x^2 + 10x$ $\underline{\quad 12x + 20}$ $6x^2 + 22x + 20$
07316	...check the accuracy of multiplying 2 binomials by substituting numbers for the letters, forming an equivalent numerical problem, and comparing the evaluation of the product.
07317	...calculate the product of a binomial and a trinomial.
07318	...calculate the product of 2 trinomials.

MBO LIST

Upon completion of this segment, the student should be able to:

MBO CODE	
07410	...calculate areas of some geometric figures.
07411	...recognize and apply the principle: area is expressed in square units.
07412	...evaluate the area of a rectangle, when its length and width are given.
07413	...express the area of a rectangle, when its dimensions are polynomials.
07414	...express a side of a rectangle, when its area and an adjacent side are given.
07415	...calculate areas of figures that can be decomposed into a number of rectangles. e.g. the figures below:
07416	...calculate the area of a figure composed of a rectangle and a triangle.
07417	...calculate the area of a ring formed by 2 concentric circles.
07418	...calculate the area of a figure composed of a rectangle and a semi-circle.
07419	...calculate the total area of the sides of a rectangular block.

MBO CODE	
07420	...solve verbal problems dealing with areas.
07421	...solve an equation involving the product of polynomials.
07422	...translate a verbal statement involving areas into an equation.
07423	...solve verbal problems dealing with areas of rectangles, and involving the product of a monomial by a binomial.
07424	...solve verbal problems dealing with areas of rectangles, and involving products of binomials.
07425	...solve verbal problems dealing with areas of circles.

MBO LIST

Upon completion of this segment the student should be able to:

MBO CODE

07510 ...calculate the quotient of powers.

07511 ...recognize the reciprocal of quantity.

The reciprocal of N is $\frac{1}{N}$

The reciprocal of $\frac{a}{b}$ is $\frac{b}{a}$

07512 ...recognize and apply the principle: dividing by a number is the same as multiplying by the reciprocal of the number.

$$a \div b = a \cdot \frac{1}{b}$$

07513 ...recognize that dividing a quantity by zero is not a defined operation.

$$\frac{a}{b} = N \quad \text{where} \quad b \neq 0$$

07514 ...calculate the quotient of two quantities with the same base when the numerator is raised to a larger power.

e.g.

$$\frac{x^a}{x^b} = x^{a-b} \qquad a > b$$

07515 ...calculate the quotient of two quantities with the same base when the numerator is raised to a lower power than the denominator.

e.g.

$$\frac{x^a}{x^b} = \frac{1}{x^{b-a}} \quad \text{where } a < b$$

07516 ...calculate the quotient of two positive monomials.

e.g.

$$\frac{20x^3}{4x} = 5x^2$$

07517 ...calculate the quotient of two negative monomials.

e.g.

$$\frac{-7a^3b}{-21a^2b^4} = \frac{a}{3b^3}$$

07518 ...calculate the quotient of two monomials with positive and negative signs.

e.g.

$$\frac{20xy^2}{-10x^2y} = -\frac{2y}{x}$$

$$\frac{-45x^3}{9x} = -5x^2$$

07519 ...calculate the quotient of two monomials containing literal powers.

e.g.

$$\frac{-6a^nb^m}{2a^2b^3} = -3a^{n-2}b^{m-3}$$

MBO LIST

Upon completion of this segment, the student should be able to:

MBO CODE	
08110	...divide a polynomial by a monomial.
08111	...recognize and apply the principle: dividing the sum of 2 numbers by a number is the same as dividing each of the numbers by that number and adding the result, e.g. $\frac{32 + 8}{4} = \frac{32}{4} + \frac{8}{4}$
08112	...recognize and apply the principle: dividing the difference of 2 numbers by a positive number is the same as dividing each of the numbers by that number and subtracting the result, e.g. $\frac{40 - 16}{8} = \frac{40}{8} - \frac{16}{8}$
08113	...recognize and apply the principle: dividing a polynomial by a letter is the same as dividing each of the terms of the polynomial by that letter, and combining the results obtained, e.g. $\frac{ax + ay - az}{a} = \frac{ax}{a} + \frac{ay}{a} - \frac{az}{a}$
08114	...calculate the quotient of a polynomial and a number, e.g. $\frac{12x + 16y}{4} = 3x + 4y$

08115 ...calculate the quotient of a polynomial and a letter,
e.g.

$$\frac{2a^2 + 6a}{a} = 2a + 6$$

08116 ...calculate the quotient of a polynomial and a monomial containing one letter and a numerical coefficient,
e.g.

$$\frac{15y^2 - 3y}{5y} = 3y - \frac{3}{5}$$

08117 ...calculate the quotient of a polynomial and a monomial containing powers of letters,
e.g.

$$\frac{8x^3 - 16xy^2 + 4xy}{4x^2y} = \frac{2x}{y} - \frac{4y}{x} + \frac{1}{x}$$

08118 ...calculate the quotient of a polynomial and a negative monomial.

08119 ...evaluate the quotient of a polynomial and monomial when numerical values of the letters are specified.

MBO LIST

Upon completion of this segment, the student should be able to:

MBO CODE	
08210	...divide a polynomial by a polynomial.
08211	...calculate a long division problem in arithmetic.
08212	...recognize and apply the principle: the process of division consists of repeated subtractions.
08213	...recognize and apply the principle: $\frac{\text{dividend}}{\text{divisor}} = \text{quotient} + \frac{\text{remainder}}{\text{divisor}}$
08214	...recognize and apply the principle: a polynomial can be written with the exponents of one variable arranged in decreasing numerical order.
08215	...recognize the similarity between the pattern used in arithmetic division and the one used in division of a polynomial by a polynomial.
08216	...divide a polynomial by a polynomial when there is no remainder.
08217	...divide a polynomial by a polynomial where there is a remainder.
08218	...divide a polynomial by a polynomial where missing terms must be inserted. e.g., $ax^3 + ox^2 + bx + c \quad (x + d)$
08219	...recognize when the operation of division is completed, that is, when the remainder is zero or is of a degree less than that of the divisor.

MBO LIST

Upon completion of this segment, the student should be able to:

MBO CODE	
08310	...express a monomial as the product of 2 or more factors.
08311	...recognize and apply the principle: a number can be written as the product of 2 or more numbers, e.g. 84 = 21 2 2
08312	...1 is a factor of any quantity
08313	...recognize the difference between writing a number as the product of integers, and writing a number as the product of integers, and fractions
08314	...recognize the meaning of the "factors of a number."
08315	...recognize the meaning of "prime factors of a number."
08316	...express a number as a product of prime factors.
08317	...calculate the largest common factor of 2 integers.
08318	...recognize the largest numerical coefficient that is a factor of 2 given monomials.
08319	...recognize the greatest degree in each variable that is a factor of 2 given monomials.

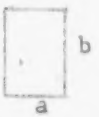
MBO LIST

Upon completion of this segment, the student should be able to:

MBO CODE	
08320	...identify common factors of a polynomial.
08321	...recognize the largest number that is a factor of polynomial, e.g. 7 is the largest common numerical factor of $7a + 14b + 21c$
08322	...recognize the greatest degree in one variable that is a factor of a polynomial, the second degree of a, a^2, is the largest common factor of $5a^4 - 6a^3 + 8a^2$
08323	...recognize that the factors of a letter to the first degree are that letter and 1. (not 0), e.g. the factors of a are a and 1
08324	...recognize the words: common monomial factor, and greatest common monomial factor.
08325	...factor a polynomial by removing the greatest common monomial factor.
08326	...factor a polynomial by grouping.
08327	...solve area problems involving factoring.

MBO LIST

Upon completion of this segment, the student should be able to:

MBO CODE	
08410	...recognize and apply the principle: the product of the sum and difference of 2 numbers, a and b , can be expressed as $(a + b)(a - b)$
08411	...calculate the square of a number.
08412	...calculate the square of a monomial e.g. $(ab)^2 = a^2b^2$
08413	...recognize that the product of 2 quantities can be represented by areas of rectangles. e.g. ab is the area of 
08414	...calculate the product of numbers by writing one of the numbers as a sum of 2 numbers, and the other as the difference of the same numbers, e.g. $11(9) = (10 + 1)(10 - 1)$
08415	...recognize 2 binomials that differ only in the sign between the terms, e.g. $x + 3$ / $\underline{x - 3}$

MBO LIST

Upon completion of this segment, the student should be able to:

MBO CODE	
08420	...factor the difference of 2 squares. $a^2 - b^2 = (a + b)(a - b)$
08421	...recognize that the symmetric property holds for the relation <u>equals</u>, e.g. $(a - b)(a + b) = a^2 - b^2$ and $a^2 - b^2 = (a - b)(a + b)$
08422	...calculate the square root of a number, e.g. square root of 36 is $\pm$ 6
08423	...calculate the square root of a monomial that is a perfect square, e.g. the square root of $4a^2$ is $\pm$ 2a
08424	...recognize that an expression which is the difference of 2 numbers that are squared can be expressed as the multiplication of 2 binomials that consist of the sum and difference of the square roots of the numbers.
08425	...factor the difference of the square of a number and a variable. e.g. $16 - x^2 = (4 + x)(4 - x)$
08427	...factor the difference of 2 squares where each square consists of more than one letter, e.g. $a^2b^2 - 81c^2 = (ab + 9c)(ab - 9c)$

MBO LIST

Upon completion of this segment, the student should be able to:

MBO CODE	
08510	...recognize and apply the principle: for squaring a binomial. $(a + b)^2 = a^2 + 2ab + b^2$
08511	...recognize that squaring the binomial $(a + b)$ is equivalent to finding the area of a square of side $(a + b)$
08512	...calculate the square of a binomial by the method used in multiplying 2 polynomials.
08513	...calculate double the product of 2 numbers, e.g. double the product of $2a$ and $3b$ = $2(2a \cdot 3b) = 12ab$
08514	...calculate the square of a binomial consisting of the sum of 2 single-letter variables. e.g. $(x + y)^2 = x^2 + 2xy + y^2$
08515	...calculate the square of a binomial consisting of the sum of 2 monomials, e.g. $(2a + 3b)^2 = 4a^2 + 12ab + 9b^2$
08516	...calculate the square of a binomial consisting of the difference of 2 single-letter variables. e.g. $(m - n)^2 = m^2 - 2mn + n^2$
08517	...calculate the square of a binomial consisting of the difference of 2 monomials, e.g. $(3r - 4s)^2 = 9r^2 - 24rs + 16s^2$

MBO LIST

Upon completion of this segment, the student should be able to:

MBO CODE	
09110	...factor a trinomial square: $a^2 + 2ab + b^2 = (a + b)^2$
09111	...recognize that a trinomial is a polynomial consisting of 3 terms.
09112	...recognize the requirements needed for a trinomial to be a trinomial square.
09113	...recognize that a trinomial square is equivalent to the square of a binomial.
09114	...factor a trinomial square containing only one variable and having all terms positive, e.g. $x^2 + 8x + 16 = (x + 4)^2$
09115	...factor a trinomial square containing more than one letter variable and having all terms positive, e.g. $a^2x^2 + 2abx + b^2 = (ax + b)^2$
09116	...factor a trinomial square having the middle term negative, e.g. $a^2 - 2a + 1 = (a - 1)^2$
09117	...recognize and factor a trinomial square when it is of degree higher than 2, e.g. $n^4 - 2n^2 + 1 = (n^2 - 1)^2$
09118	...calculate the value of the coefficient of the middle term in order for a trinomial to be a trinomial square, e.g. the value of k which will make $x^2 + kx + c^2$ a trinomial square is $k = 2\sqrt{c}$

MBO LIST

Upon completion of this segment, the student should be able to:

MBO CODE	
09210	...multiply 2 binomials of the form $(ax + b)(cx + d)$ at sight.
09211	...recognize and apply the principle: the product of 2 binomials can be calculated by the method used in multiplying 2 polynomials - and the result is a trinomial, except when the binomials are the sum and difference of the same 2 numbers.
09212	...recognize and apply the principle: the first term of the product of 2 binomials of the form $(ax + b)(cx + d)$ is the product of first 2 terms of the binomials: acx^2 .
09213	...recognize and apply the principle: the third term of the product of 2 binomials of the form $(ax + b)(cx + d)$ is the product of the last 2 terms of the binomials: $+ bd$
09214	...recognize the meaning of the terms: "inner and outer partial products" in multiplying 2 binomials of the form $(ax + b)(cx + d)$ inner product = bcx, outer product = adx

MBO LIST

09215 ...recognize and apply the principle the middle term of the product of 2 binomials of the form $(ax + b)(cx + d)$ is the sum of the inner and outer products: $(bc + ad)x$

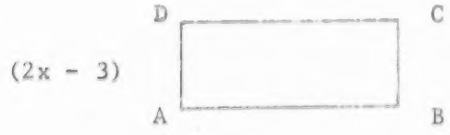
09216 ...multiply at sight 2 binomials, each being the sum of 2 terms
$(ax + b)(cx + d) = acx^2 + (bc + ad)x + bd$

09217 ...multiply at sight 2 binomials, both of which are the difference of 2 terms
$(ax - b)(cx - d) = acx^2 - (bc + ad)x + bd$

09218 ...multiply at sight 2 binomials, one of which is the sum and the other is the difference of 2 terms
$(ax + b)(cx - d) = acx^2 + (bc - ad)x - bd$

09219 ...express the area of a rectangle, where the length and width are each binomials

e.g. express the area of rectangle ABCD



(3x + 7)

Area of ABCD =

$(2x - 3)(3x + 7) = 6x^2 + 5x - 21$

MBO LIST

Upon completion of this Segment, the student should be able to:

MBO CODE

09310 ...factor a trinomial which is the product of binomial sums or the product of binomial differences $x^2 + (a + b)x + ab = (x + a)(x + b)$

$x^2 - (a + b)x + ab = (x - a)(x - b)$

09311 recognize and apply the principle: the binomial factorization of a trinomial with only positive signs contains only plus signs.

e.g. $x^2 + 8x + 12$ is of the form $(x + \ )\ (x + \ )$.

09312 calculate the factors of the constant term of the trinomial of the form $x^2 + (a + b)x + ab$

e.g. the possible pairs of factors of the constant, 12 of $x^2 + 8x + 12$ are 1,12; 2,6; and 3,4

09313 recognize and apply the principle: the second terms of each of the binomials are factors of the last term of the trinomial,

e.g. in $x^2 + 8x + 12$, the second terms must be either 1,12 or 2,6 or 3,4.

i.e. $(\ +1)\ (\ +12)$

$(\ +2)\ (\ +6)$

$(\ +3)\ (\ +4)$

09314 recognize and apply the principle: the sum of the factors of the constant term equals the coefficient of the second term of the trinomial, of the form $x^2 + (a + b)\ x + ab$

e.g. in $x^2 + 8x + 12$, the factors 2,6, must be chosen for a and b in order to equal 8 .

09315 multiply the 2 binomial factors constructed to check whether their product equals the original trinomial.

09316 recognize and apply the principle: the binomial factors of a trinomial with all signs positive and the middle term negative, consist of 2 binomials with negative signs between the terms.

e.g. $x^2 - 8x - 12$ must be of the form $(x - \ )\ (x - \ )$.

MBO LIST

09317 recognize that there are trinomials that cannot be written as the product of 2 binomial sums or differences.

09318 recognize that trinomials that cannot be factored over the set of integers are called prime.

09320 ...factor a trinomial which is the product of a binomial sum and binomial difference,

e.g. $x^2 + (a - b)x - ab = (x + a)(x - b)$; $(a > b)$, using the following sequence of operations:

09321 recognize that the sign pattern of the factors is of the form $(x + \ )\ (x - \ )$.

09322 find all the possible factors of the constant of the trinomial.

09323 recognize and apply the principle: the factors of the last term of the trinomial must be chosen so that their absolute value difference is the numerical coefficient of the second term of the trinomial.

e.g. in $x^2 - 17x - 18$, -18, 1 are the required factors.

09324 recognize and apply the principle: if the sign of the second term of the trinomial is minus, the factor with the largest absolute value, has the minus sign

09325 recognize and apply the principle: if the sign of the second term of the trinomial is plus, the factor with the largest absolute value has the plus sign.

09326 calculate the product of the 2 binomial factors to check whether their product equals the original trinomial.

MBO LIST

Upon completion of this segment, the student should be able to:

MBO CODE	
09410	...factor general quadratic trinomials, using the following sequence of operations:
09411	recognize the form of a general quadratic trinomial, that is, $ax^2 + bx + c$
09412	enumerate the possible factors of a trinomial of the form $ax^2 + bx + c$, where the coefficient of the second degree term, a, and the constant term, c, are each prime numbers.
09413	enumerate the possible factors of a trinomial of the form $ax^2 + bx + c$, where only the coefficient of the second degree term, a, is a prime number.
09414	enumerate the possible factors of a trinomial of the form $ax^2 + bx + c$, where both the coefficient of the second degree term, a, and the constant term, c, are composite numbers.
09515	multiply each of the possibilities being considered to check which of the products equals the original trinomial.

MBO CODE

Upon completion of this segment, the student should be able to:

MBO CODE	
09510	...combine types of factoring, using the following sequence of operations:
09511	recognize whether the expression to be factored has a common monomial factor, and that this factor should be removed first.
09512	recognize whether the expression is the difference of two squares, and if so, factor it.
09513	recognize whether the trinomial is a square, and if so, factor it.
09514	recognize that a trinomial which is not a square, can sometimes be expressed as the product of 2 binomials, and if so, determine the factors.
09515	recognize that a polynomial can be factored by grouping, and if so, factor it.
09516	recognize that all factors of a trinomial including the monomial factor must be written in order to be equal to it.
09517	calculate the product of the factors to check that this product equals the original trinomial.

MBO LIST

Upon completion of this segment, the student should be able to:

MBO CODE	
10110	...solve quadratic equations consisting of the product of 2 binomials equal to zero.
10111	...recognize that if the product of 2 quantities is zero, at least one of the quantities equals zero.
10112	...recognize that if the product of an arithmetic number and a binomial equals zero, then the binomial equals zero. e.g. $3(x - 2) = 0$ implies $x - 2 = 0$
10113	...recognize that if the product of 2 binomials equals zero, each of the binomials may be a zero. e.g. $(x - 2)(x + 3) = 0$ implies $x - 2 = 0$, $x + 3 = 0$.
10114	...recognize that if the product of an arithmetic number and 2 binomials equals zero, then each of the binomials may be zero. e.g. $3(x - 5)(x - 3) = 0$ implies $x - 5 = 0$ and $x - 3 = 0$.

MBO LIST

Upon completion of this segment, the student should be able to:

MBO CODE	
10210	...solve quadratic equations by factoring, using the following sequence of operations:
10211	express a polynomial equation in the standard form, $ax^2 + bx + c = 0$
10212	recognize the degree of a polynomial equation as linear, quadratic or cubic.
10213	factor the left side of a polynomial equation after it has been put into standard form.
10214	equate each factor to zero.
10215	solve the resulting equations.
10216	check each result (root) in the original equation.
10217	recognize that a quadratic equation has 2 solutions, called roots of the equation.
10218	recognize that if the common monomial factor contains a variable, one of the roots is zero. e.g. $x^2 - 4x = 0$ implies $x(x - 4) = 0$ implies $x = 0$, $x = 4$.
10219	recognize that only polynomial equations that can be factored, can be solved by this method.

MBO LIST

Upon completion of this segment, the student should be able to:

MBO CODE	
10310	...use factoring to solve an equation in one unknown, derived from verbal problems, using the following sequence of operations:
10311	recognize and apply the principle: if the sum of 2 quanities is a given number, N, and one of the quantities is denoted by x, the other quantity is denoted by N-X
10312	write the equation for a verbal problem where the sum and product of 2 numbers are given. e.g. if the sum of 2 numbers is 25 and their product is 100, find the numbers. The equation is $x(25 - x) = 100$
10313	solve the resulting polynomial equation by factoring.
10314	check the results obtained with the original problem.
10315	recognize that sometimes in practical problems one of the 2 possible solutions is acceptable. e.g. a negative answer to the length of a side of a rectangle is rejected.
10316	apply the above concept to problems involving perimeters and area of rectangles.

MBO LIST

Upon completion of this segment, the student should be able to:

MBO CODE	
10410	...recognize and define the quotient of 2 algebraic expressions as an algebraic fraction.
10411	...recognize and apply the principle: a fraction is not defined when its denominator is zero.
10412	...calculate the value of the letter for which the fraction is not defined, e.g. $\frac{a}{x - b}$ is not defined for $x = b$
10413	...write as a fraction 2 expressions separated by a division sign. e.g. $x \div (x + a) = \frac{x}{x + a}$
10414	...find the excluded values of a fraction when the denominator is a quadratic expression. e.g. $\frac{ax}{x^2 - b^2}$ is undefined for $x = \pm b$
10415	...evaluate a fraction when numerical values of the letters are given. e.g. find the numerical value of $\frac{x + 4}{x^2}$, when $x = 3$

MBO LIST

Upon completion of this segment, the student should be able to:

MBO CODE

10420 ...reduce fractions to lowest terms.

10421 ...recognize and apply the principle: the quotient of 2 equal numbers, is 1 .

i.e. $\frac{a}{a} = 1 \quad (a \neq 0)$

10422 ...recognize and apply the principle: dividing or multiplying the numerator and denominator of a fraction by the same non-zero number, produces an equivalent fraction.

i.e. $\frac{a}{b} = \frac{ac}{bc}$

10423 ...recognize and apply the principle: a fraction is in its lowest terms when the numerator and denominator have no common factors other than 1 and -1 .

10424 ...find the greatest common factor of the numerator and denominator.

10425 ...reduce to lowest terms a fraction consisting of the quotient of 2 monomials

e.g. $\frac{5xy^2}{3x^2y} = \frac{5y}{3x}$

10426 ...recognize that individual terms in the numerator cannot be cancelled with individual terms in the denominator.

e.g. $\frac{a + b}{a + c} \neq \frac{b}{c} \qquad (a \neq 0)$

10427 ...reduce to lowest terms a fraction consisting of the quotient of a linear and quadratic expression.

e.g. $\frac{x + a}{x^2 + 2ax + a^2} = \frac{1}{x + a}$

10428 ...reduce to lowest terms a fraction consisting of the quotient of 2 quadratic trinomials.

10429 ...reduce a fraction to lowest terms when (-1) has to be introduced as a factor.

e.g. $\frac{x^2 - 16}{4 - x} = \frac{x^2 - 16}{-1(x - 4)} = -(x + 4)$

MBO LIST

Upon completion of this segment, the student should be able to:

MBO CODE

10510 ...recognize and apply the rule for multiplying fractions:

$$\frac{a}{b} \cdot \frac{c}{d} = \frac{ac}{bd}$$

10511 ...multiply two arithmetic fractions:

e.g. $\frac{3}{7} \cdot \frac{5}{4}$ or $\left(\frac{3}{7}\right)\left(\frac{5}{4}\right) = \frac{15}{28}$

10512 ...recognize and apply the principle: a whole number is equivalent to a fraction with a denominator of one:

e.g. $5 = \frac{5}{1}$

10513 ...recognize and apply the principle: multiplication of fractions can be simplified by factoring if possible and reducing fractions if possible.

10514 ...multiply fractions involving the factoring of monomials,

e.g. $\frac{4t}{5r} \cdot \frac{15r}{6t} = \frac{2 \cdot 2 \cdot t \cdot 3 \cdot 5 \cdot r}{5 \cdot r \cdot 2 \cdot 3 \cdot t} = 2$

10515 ... multiply fractions involving the factoring of binomials,

e.g. $\frac{a^2 - b^2}{a + b} \cdot \frac{a + b}{a - b} = \frac{(a + b)(a - b)(a + b)}{(a + b)(a - b)} = (a + b)$

10516 ...multiply fractions involving the factoring of binomials and trinomials

e.g. $\frac{x^2 + 4x + 3}{x^2 - 4x - 5} \cdot \frac{x - 5}{x + 3} = \frac{(x + 3)(x + 1)(x - 5)}{(x + 3)(x + 1)(x - 5)} = 1$

MBO LIST

Upon completion of this segment, the student should be able to:

MBO CODE

10520 ...recognize and apply the rule for dividing fractions:

$$\frac{a}{b} \div \frac{c}{d} = \frac{a}{b} \cdot \frac{d}{c}$$

10521 ...recognize and apply the principle: the reciprocal of a whole number is the quotient of 1 and that number, and conversely,

e.g. the reciprocal of 5 is $\frac{1}{5}$

the reciprocal of $\frac{1}{5}$ is 5

10522 ...recognize and apply the principle: the reciprocal of a fraction is the quotient of 1 and that fraction, and conversely,

e.g. the reciprocal of $\frac{a}{b}$ is $\frac{b}{a}$

the reciprocal of $\frac{1}{\frac{a}{b}}$ is $\frac{a}{b}$

10523 ...recognize and apply the principle: the reciprocal of a fraction is the fraction obtained by exchanging the numerator and denominator,

e.g. the reciprocal of $\frac{a}{b}$ is $\frac{b}{a}$

10524 ...divide two arithmetic fractions:

e.g. $\frac{3}{7} \div \frac{5}{4} = \frac{3}{7} \cdot \frac{4}{5}$

MBO LIST

Upon completion of this segment, the student should be able to:

MBO CODE

10525 ...divide fractions involving the factoring of monomials

$$\frac{4t}{5r} \div \frac{6t}{15r} = \frac{4t}{5r} \cdot \frac{15r}{6t} = \frac{2 \cdot 2 \cdot t \cdot 3 \cdot 5 \cdot r}{5 \cdot r \cdot 2 \cdot 3 \cdot t} = 2$$

10526 ...divide fractions involving the factoring of binomials,

e.g. $\frac{a^2 - b^2}{a + b} \div \frac{a - b}{a + b} = \frac{(a + b)(a - b)}{a + b} \cdot \frac{a + b}{a - b} = (a + b)$

10527 ...divide fractions involving the factoring of monomials and binomials

e.g. $\frac{2(x - 3)}{3} \div \frac{(6x - 18)}{12} = \frac{2(x - 3)}{3} \cdot \frac{3 \cdot 2 \cdot 2}{3 \cdot 2 \cdot (x - 3)} = \frac{4}{3}$

10528 ...divide fractions involving the factoring of binomials and trinomials,

e.g. $\frac{x^2 + 4x + 3}{x^2 - 4x - 5} \div \frac{x + 3}{x - 5} = \frac{(x + 3)(x + 1)}{(x - 5)(x + 1)} \cdot \frac{x - 5}{x + 3} = 1$

MBO LIST

Upon completion of this segment, the student should be able to:

MBO CODE	
11110	...perform calculations involving multiplication and division of fractions.
11111	...perform the combined operation of multiplication and division of arithmetic fractions. e.g. find the value of $\frac{3}{5} \div \frac{10}{12} \cdot \frac{1}{2}$
11112	...recognize and apply the principle: the order of the operations is significant. That is, in the example $\frac{3}{5} \div \frac{10}{12} \cdot \frac{1}{2}$ is not the same as $\frac{3}{5} \div (\frac{10}{12} \cdot \frac{1}{2})$
11113	...recognize and apply the principle: only the fraction immediately following the division sign is replaced by its reciprocal, e.g. $\frac{3}{5} \div \frac{10}{12} \cdot \frac{1}{2} = \frac{3}{5} \cdot \frac{12}{10} \cdot \frac{1}{2}$
11114	...multiply and divide fractions consisting of monomials, e.g. $\frac{a^2b}{c} \cdot \frac{c^3d}{a^3} \div \frac{b^2d}{c}$
11115	...multiply and divide fractions consisting of monomials and binomials, e.g. $\frac{x^2 - 1}{x^2} \cdot \frac{x}{x - 1} \div \frac{x + 1}{5}$
11116	...multiply and divide fractions consisting of binomials and trinomials.
11117	...check the result of a calculation involving algebraic fractions by substituting numerical values for the letters.

MBO LIST

Upon completion of this segment, the student should be able to:

MBO CODE	
11210	...recognize and apply the rule for adding like fractions: $\frac{a}{b} + \frac{c}{b} = \frac{a + c}{b}$
11211	...recognize and apply the principle: like fractions have the same denominator.
11212	...add like arithmetic fractions. e.g. $\frac{8}{17} + \frac{3}{17} = \frac{11}{17}$
11213	...add like algebraic fractions with monomial denominators. e.g. $\frac{4a}{3x} + \frac{13}{3x} = \frac{4a + 13}{3x}$
11214	...add like algebraic fractions with binomial denominators. e.g. $\frac{3a}{x + y} + \frac{13}{x + y} = \frac{3a + 13}{x + y}$
11215	...add like algebraic fractions with binomial numerators and monomial denominators. e.g. $\frac{x + 3}{a} + \frac{x + 4}{a} = \frac{2x + 7}{a}$
11216	...add like algebraic fractions with binomial numerators and binomial denominators. e.g. $\frac{x + 3}{a + b} + \frac{x + 6}{a + b} = \frac{2x + 9}{a + b}$

MBO LIST

Upon completion of this segment, the student should be able to:

MBO CODE	
11220	...recognize and apply the rule for subtracting like fractions: $\frac{a}{b} - \frac{c}{b} = \frac{a - c}{b}$
11221	...subtract like arithmetic fractions. e.g. $\frac{8}{17} - \frac{3}{17} = \frac{5}{17}$
11222	...subtract like algebraic fractions with monomial denominators. e.g. $\frac{4a}{3x} - \frac{13}{3x} = \frac{4a - 13}{3x}$
11223	...subtract like algebraic fractions with binomial denominators. e.g. $\frac{3a}{x + y} - \frac{13}{x + y} = \frac{3a - 13}{x + y}$
11224	...subtract like algebraic fractions with binomial numerators and monomial denominators where the numerator of the subtrahend is of the form a + b, e.g. $\frac{x + 3}{5b} - \frac{x + 4}{5b} = \frac{-1}{5b}$
11225	...subtract like algebraic fractions with binomial numerators and monomial denominators where the numerator of the subtrahend is of the form a - b, e.g. $\frac{x + 3}{5b} - \frac{x - 4}{5b} = \frac{7}{5b}$
11226	...subtract like algebraic fractions with binomial numerators and binomial denominators e.g. $\frac{x + 3}{a + b} - \frac{x + 6}{a + b} = \frac{-3}{a + b}$.
11230	...recognize and apply the principle: "combine fractions" means to use the rules for addition or subtraction as required: e.g. combine: $\frac{a}{b} + \frac{c}{b} - \frac{d}{b} = \frac{a + c - d}{b}$

MBO LIST

Upon completion of this segment, the student should be able to:

MBO CODE	
11310	...change a fraction to an equivalent fraction.
11311	..change a fraction to an equivalent fraction having a specified numerical denominator. e.g. change the fraction $\frac{3}{5}$ to an equivalent fraction having a denominator of 15 . $\frac{3}{5} = \frac{9}{15}$
11312	...change a literal fraction to an equivalent fraction having a specified literal denominator. For example, change $\frac{5a}{2b}$ to an equivalent fraction having a denominator: 6bc . $\frac{5a}{2b} = \frac{15ac}{6bc}$
11313	...calculate the least common multiple (LCM) of 2 numbers. e.g. The least common multiple of 12 and 15 is 60 .
11314	...calculate the least common multiple of 2 monomials. e.g. The L.C.M. of $2a^2$ and 6ab is $6a^2b$

MBO LIST

Upon completion of this segment, the student should be able to:

MBO CODE

11320 ...recognize and apply the principle: to combine fractions with unlike denominators, first change the fractions to equivalent fractions with like denominators.

11321 ...calculate the least common multiple (LCM) of 2 binomials.
e.g. the LCM of $(a + b)$ and $(a^2 - b^2)$ is $a^2 - b^2$

11322 ...combine fractions with different monomial denominators consisting of multiples of one letter, e.g.
$$\frac{b}{2a} + \frac{c}{3a} - \frac{d}{4a} = \frac{6b + 4c - 3d}{12a}$$

11323 ...combine fractions with different monomial denominators consisting of more than one letter, e.g.
$$\frac{3x}{2ab} + \frac{5y}{3a^2b} - \frac{7z}{6ab^2} = \frac{9abx + 10by - 7az}{6a^2b^2}$$

11324 ...combine fractions with different monomial denominators and binomials in the numerators, e.g.
$$\frac{x + 4}{3a} - \frac{2 - x}{2b} = \frac{2b(x + 4) - 3a(2 - x)}{6ab}$$

11324 ...combine fractions with different binomials as denominators, e.g.
$$\frac{3a}{2a + 6} - \frac{a - 1}{a + 3} = \frac{3a - 2(a - 1)}{2(a + 3)}$$

11326 ...combine fractions containing a denominator which is the difference of 2 squares, e.g.
$$\frac{1}{a^2 - b^2} + \frac{3}{a + b} = \frac{1 + 3(a - b)}{(a + b)(a - b)}$$

11327 ...combine fractions with a trinomial in the denominator, e.g.
$$\frac{6x - 13}{x^2 - 5x + 6} - \frac{5}{x - 3} = \frac{6x - 13 - 5(x - 2)}{(x - 3)(x - 2)}$$

MBO LIST

Upon completion of this segment, the student should be able to:

MBO CODE

11410 ...combine mixed expressions.

11411 ...recognize that a mixed number can be written as the sum of an integer and a fraction, e.g.

$$2\frac{1}{3} = 2 + \frac{1}{3}$$

11412 ...change a mixed number to an improper fraction, e.g.

$$4\frac{2}{5} = \frac{22}{5}$$

11413 ...express a mixed number as a fraction, e.g.

$$a + \frac{2}{a} = \frac{a^2 + 2}{a}$$

11414 ...express a fraction as a mixed expression, e.g.

$$\frac{3x - 2}{x} = 3 - \frac{2}{x}$$

11415 ...express a mixed expression as a single fraction, when the denominator is a binomial, e.g.

$$x - \frac{2x}{x - 2} = \frac{x^2 - 4x}{x - 2}$$

11416 ...multiply 2 mixed expressions, e.g.

$$\left[x - \frac{1}{x}\right]\left[1 + \frac{1}{x + 1}\right] = \frac{x^2 - 1}{x} \cdot \frac{x + 2}{x + 1}$$

$$= \frac{(x - 1)(x + 2)}{x}$$

11420 ...divide 2 mixed expressions, e.g.

$$\left[2 + \frac{4}{x - 2}\right] \div \left[\frac{x}{x - 2} + 1\right] = \frac{2x}{x - 2} \cdot \frac{x - 2}{2x - 2}$$

$$= \frac{x}{x - 1}$$

MBO LIST

Upon completion of this segment, the student should be able to:

MBO CODE

11430 ...simplify complex fractions.

11431 ...recognize the meaning of a complex fraction, e.g.

$$\frac{4}{\frac{2}{3}}, \qquad \frac{\frac{1}{a}}{a}, \qquad \frac{1 - \frac{1}{a}}{a + 1}$$

are called complex fractions.

11432 ...simplify a complex fraction consisting of the quotient of a fraction and a number, e.g. $\frac{\frac{2}{3}}{4} = \frac{2}{12} = \frac{1}{6}$

11433 ...simplify the complex fraction consisting of the quotient of a number and a fraction, e.g. $\frac{4}{\frac{5}{6}} = 4 \cdot \frac{6}{5} = \frac{24}{5}$

11434 ...simplify the quotient of 2 fractions, e.g.

$$\frac{\frac{1}{2}}{\frac{2}{3}} = \frac{1}{2} \cdot \frac{3}{2} = \frac{3}{4}$$

11435 ...simplify a fraction where the numerator is a mixed expression, e.g.

$$\frac{1 + \frac{a}{b}}{c} = \frac{1}{c} + \frac{a}{bc}$$

11436 ...simplify a fraction where both numerator and denominator is a mixed expression, e.g.

$$\frac{1 - \frac{1}{1 - x}}{1 - \frac{x}{x - 1}} = \frac{1 - x - 1}{1 - x} \div \frac{1 - x + x}{1 - x}$$

$$= -x$$

MBO LIST

Upon completion of this segment, the student should be able to:

MBO CODE	
11510	...solve open sentences with fractional coefficients
11511	recognize and apply the principle: two open sentences with the same solution set are called equivalent equations.
11512	recognize and apply the principle: an open sentence can be changed to an equivalent open sentence by multiplying both sides by the same quantity. Thus, $\frac{x}{2} + \frac{x}{3} = 5$ (multiplied by 6) becomes: $3x + 2x = 30$ and the two are equivalent.
11513	find the lowest common denominator of an open sentence with fractional coefficients. e.g. the L.C.D. of $\frac{x}{2} + \frac{x}{3} = 5$ is 6
11514	change an open sentence with fractional coefficients to an equivalent sentence with integral coefficients.
11515	solve the linear equation resulting from changing an equation with fractional coefficients to one with integral coefficients.
11516	check the solution set obtained in solving the open sentence that contained fractional coefficients.

MBO LIST

Upon completion of this segment, the student should be able to:

MBO CODE	
12110	...solve verbal investment problems
12111	recognize and apply the principle: simple interest (I) on an amount of money (P), invested at a certain annual rate (R) for one year, is the product of that amount and the rate. i. e. $I = P \cdot R$
12112	recognize and apply the principle: simple interest on an amount of money invested at a certain annual rate for (t) years is given by the formula: $I = P \cdot R \cdot t$
12113	recognize and apply the principle: at the end of one year, an investment of (P) dollars at (R) annual rate of interest will result in the investor having $(P + PR)$ dollars.
12114	express the percent interest rate as decimal.
12115	recognize and apply the principle: if the sum (N) of the 2 quantities is given, and one of the quantities is denoted by (x), the other quantity is $(N - x)$
12116	recognize and apply the principle: the income from 2 investments is the sum of the incomes from each investment.
12117	solve the equations that result from analysis of interest problems having decimal coefficients.
12118	check the results obtained with the original problem

MBO LIST

Upon completion of this segment, the student should be able to:

MBO CODE	
12210	...solve verbal percent mixture problems
12211	recognize and apply the principle: the addition of pure water represents the addition of a substance with no percent concentration of the other ingredient. e.g. in adding water to alcohol, water has 0% alcohol.
12212	recognize and apply the principle: the addition of a pure substance to a mixture is the addition of 100% concentration of that substance.
12213	recognize and apply the principle: the addition of an amount of a substance to a mixture increases the total mixture by that amount e.g. if 1 gallon of water is added to a mixture of x gallons, the total mixture now contains (1 + x) gallons.
12214	recognize and apply the principle: if an amount of water has been evaporated, the new mixture is reduced by that amount. e.g. if 20 ounces of water is evaporated from a solution of x ounces, the new mixture contains (x - 20) ounces.
12215	calculate the amount of pure ingredient in a mixture of a certain percent pure of that ingredient.
12216	recognize and apply the principle: the percent pure of a mixture is found by dividing the amount of total pure by the amount of total mixture and multiplying by 100 .
12217	check the results obtained with the original problem.

MBO LIST

Upon completion of this segment, the student should be able to:

MBO CODE

12310 ...solve fractional equations using the following sequence of operations:

12311 recognize and apply the principle: a fractional equation is an equation with variables in the denominators,

e.g. $\frac{3}{2x} + \frac{1}{x} = \frac{5}{9}$

12312 find the lowest common multiple of the denominators of the equation (LCD).

12313 change the fractional equation to an equation with integral coefficients by multiplying all terms by the lowest common denominator of the equation.

12314 recognize and apply the principle: multiplying a fractional equation by a variable expression which can represent zero, may produce extraneous roots.

12315 recognize and apply the principle: the solutions obtained must be checked by substituting their values in the original equation.

12316 ...solve fractional equations with binomial expressions in their denominator,

e.g.

$$4x - \frac{x}{3x - 1} = 3$$

12317 ...solve fractional equations with trinomial expressions in the denominator,

e.g. $\frac{1}{2y + 3} + \frac{1}{2y + 1} = \frac{2}{4y^2 + 8y + 3}$

MBO LIST

Upon completion of this segment, the student should be able to:

MBO CODE	
12410	...solve work problems
12411	recognize and apply the principle: the rate of working means the amount of work done in some specified unit of time. e.g. if a man can do a certain job in (a) days, in <u>one</u> day, he does $\frac{1}{a}$ of the job.
12412	recognize and apply the principle: the amount of work done is the product of the time spent working and the rate of doing work. e.g. if a man does $\frac{1}{a}$ of the job in one day he does $\frac{x}{a}$ of the job in x days.
12413	recognize and apply the principle: if several persons are working together on a job, the amount of work done in one day is the sum of the individual amounts. e.g. $\frac{1}{a} + \frac{1}{b}$ + ---- is the total amount of work done in one day.
12414	recognize and apply if several persons are working together on a job, the amount of work done in (x) days is the sum of (x) times their daily amounts. e.g. $\frac{x}{a} + \frac{x}{b}$ + --- = amount done in x days.
12415	recognize and apply the total job can be represented by 1 .
12416	write the equation indicating the amount of work performed in x days by each operator or operation to complete the job. e.g. $\frac{x}{a} + \frac{x}{b}$ + --- = 1
12417	solve the resulting equation having fractional coefficients.
12418	check the results obtained with the original problem.

MBO LIST

Upon completion of this segment, the student should be able to:

MBO CODE

12510 ...solve motion problems involving the use of fractional equations.

12511 recognize and apply the principle: distance equals the product of rate and time.
i.e. $d = r \cdot t$

12512 recognize and apply the principle: time equals the quotient of distance and rate.
i.e. $t = \frac{d}{r}$

12513 recognize and apply the principle: rate equals the quotient of distance and time.
i.e. $r = \frac{d}{t}$

12514 calculate the combined rate of an object going in the same direction of a wind or a current.
e.g. if the simple rate is "r", and rate of current is "c" then rate with current is (r + c)

12515 calculate the combined rate of an object going against a wind or current.
e.g. rate against current is (r - c)

12516 tabulate the given data of a motion problem in a chart form,

	R	x	T	=	d
with the wind					
against the wind					

12517 write a fractional equation involving the relations given between time or distance.

12518 solve the resulting fractional equation.

12519 check the results obtained with the original problem.

MBO LIST

Upon completion of this segment, the student should be able to:

MBO CODE	
13110	...write an equation in two variables to express the relationships in a verbal problem.
13111	...choose letters to represent the two variables.
13112	...translate the verbal statement of a relationship into an algebraic equation, by using the chosen variables and equivalents for standard words such as "equal to" increased by, is, twice, etc.
13120	...find the ordered pairs of numbers which are solution sets of a given equation.
13121	...recognize and apply the principle: the numbers of an ordered pair represent the x value and the y value in that order. e.g. (5, -2) means $x = 5$, $y = -2$
13122	...transform a given equation of the form $ax + by = c$ into one of the form $y = mx + k$
13123	...find the value of y which corresponds to each value of x in its replacement set.
13124	...express the solution set of an equation as a roster of ordered pairs.

MBO LIST

Upon completion of this segment, the student should be able to:

MBO CODE	
13210	...locate the point in a plane with reference to a set of Cartesian coordinate axes which corresponds to an ordered pair of numbers.
13211	...recognize and use the words axis, Cartesian coordinate axis, origin, horizontal, vertical, plot, abscissa and ordinate, in the creation and interpretation of graphs of points in a plane.
13212	...recognize the difference of position of points in a Cartesian plane naming abscissas of zero, positive or negative values.
13213	...recognize the differences of position of points in a Cartesian plane having ordinates of zero, positive or negative values.
13220	...find the ordered pair of numbers corresponding to a given point in a Cartesian plane.
13221	...recognize that the abscissa of a point means the distance, parallel to the axis, to the right or left from the Y axis to the point.
13222	...recognize that the ordinate of a point means the distance parallel to the Y axis, up or down from the X axis to the point.
13223	...recognize that a point which is on the Y axis has an abscissa of zero.
13224	...recognize that a point which is on the X axis has an ordinate of zero.

MBO LIST

Upon completion of this segment, the student should be able to:

MBO CODE	
13230	...draw the graph on a Cartesian plane of a given linear equation in two variables, x and y.
13231	...construct a table of values composed of the coordinates of at least 3 points whose coordinates satisfy the equation.
13232	...plot the location of the points from the table of values on graph paper containing Cartesian coordinates and connect them with a straight line.
13233	...draw the graph of an equation of the form $x = c$, by drawing a line through any 3 points each having an abscissa of c .
13234	...draw the graph of an equation of the form $y = c$, by drawing a line through any 3 points each having an ordinate of c .
13235	...draw the graph of an equation of the form $ax + by = c$, by locating 3 points whose coordinates fit the equation, and by connecting them with a straight line.

OPTIONAL

MBO LIST

Upon completion of this segment the student should be able to:

MBO CODE

13310 ...find the slope of a given line.

13311 ...define the value of the slope of a line as $\frac{\triangle y}{\triangle x}$

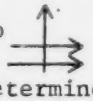
13312 ...find the value of delta y , $(\triangle y)$ from two points, (x_1, y_1) and (x_2, y_2) by subtracting the y values: $y_2 - y_1$

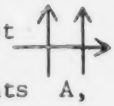
13313 ...find the value of delta x , $(\triangle x)$ from two points, (x_1, y_1) and (x_2, y_2) by subtracting the x values: $x_2 - x_1$

13314 recognize from the appearance of the line when the slope is positive:

positive:

negative:

zero 

does not exist 

13320 ...determine whether or not 3 points A, B, C are on a straight line.

13321 ...calculate the slopes of AB and BC.

13322 ...recognize that equal slopes of two lines through one point indicate that the lines and the points on the lines are collinear.

13323 ...recognize that unequal slopes of two lines through one point indicate that the lines and the points on the lines are not collinear.

13324 ...recognize that, if neither segment (AB or BC) through the same point, B, has a slope, the points A , B , and C , are collinear.

MBO LIST

Upon completion of this segment, the student should be able to:

MBO CODE	
13330	...use slope to determine the value of a variable.
13331	...find a second point on a line, given one point and the slope: e.g. $m = 3$, $(2,1)$, $(a,4)$, find a.
13332	...find the value of a variable given the slope: e.g. $m = 2$, $(a, 1)$, $(2a, 5)$, find a.
13340	...graph a line by the slope-intercept method, given its equation in the form $ax + by = c$, $b \neq 0$.
13341	...transform the equation from $ax + by = c$ to $y = mx + b$.
13342	...recognize the value of the slope, $m = \frac{\Delta y}{\Delta x}$ m from the form $y = mx + b$.
13343	...recognize the value of the y intercept, b, from the form $y = mx + b$.
13344	...locate the y intercept, (b), on the graph.
13345	...use the slope $m = \frac{\Delta y}{\Delta x}$, to locate a second point, $(\Delta x, b + \Delta y)$
13346	...draw the line through the y intercept and the 2nd point found by using the slope.

MBO LIST

Upon completion of this segment, the student should be able to:

MBO CODE	
13410	...graph a line given its equation in the form $ax + by = c$.
13411	...graph a line when $b = 0$, given the form $ax + by = c$
13412	...graph a line when $a = 0$, given the form $ax + by = c$
13413	...graph a line of the form $ax + by = c$ when $a \neq 0$, $b \neq 0$.
13420	...graph a linear inequality in two variables.
13421	...recognize and apply the principle that $y \quad mx + b$ indicates all points above the line $y = mx + b$.
13422	...recognize and apply the principle: $y \quad mx + b$ indicates all points below the line $y = mx + b$.
13423	...recognize and apply the principle: $x \quad$ ....means all points to the right of the line.
13424	...recognize and apply the principle: $x \quad$ ....means all points to the left of the line.
13425	...recognize and apply the principle: a dotted line is the graph of only the inequality; a solid line is the graph of an equation combined with an inequality, i.e. $y \quad mx + b$

MBO LIST

Upon completion of this segment, the student should be able to:

MBO CODE	
13510	...recognize from the graph of two equations whether the equations are independent or inconsistent.
13511	...determine that the equations are independent by finding that the lines intersect.
13512	...determine that the equations are dependent by finding the two lines coincide.
13513	...determine that the equations are inconsistent by finding that the two lines are parallel.
13520	...find the solution set of a pair of equations from the graph of the equations.
13521	...graph the two lines on the same set of cartesian coordinate axes.
13522	...find the coordinates of the point of intersection and call them the solution set of the two equations.
13523	...check the solution set by substituting the values in each equation.
13524	...recognize that the solution set is the empty set if the lines are parallel.
13525	...recognize that the solution set is infinite if the two lines coincide.

MBO LIST

Upon completion of this segment, the student should be able to:

MBO CODE	
14110	...solve a pair of linear simultaneous equations in two unknowns by the addition method.
14111	...recognize the conditions under which adding the two equations together will eliminate one variable.
14112	...solve for one variable, after eliminating the other by addition.
14113	...solve for the second variable, by substituting the value already found for the first in one of the equations.
14114	...check the solution by substituting both values in both equations.
14120	...solve a pair of linear simultaneous equations in two unknowns by the subtraction method.
14121	...recognize the conditions under which subtracting one equation from the other will eliminate one variable.
14122	...solve for one variable, after eliminating the other by subtraction.
14123	...solve for the second variable, by substituting the value already found for the first in one of the equations.
14124	...check the solution by substituting both values in both equations.

MBO LIST

Upon completion of this segment, the student should be able to:

MBO CODE	
14130	...solve a pair of linear simultaneous equations in two unknowns by eliminating one variable by the addition or subtraction method after multiplying each equation by the appropriate number.
14131	...find the lowest common multiple of the x coefficients and of the y coefficients.
14132	...find what multiplier is needed in the first equation, and what multiplier is needed in the second, so that equal coefficients will be produced for one of the variables.
14133	...multiply all terms in each equation by the appropriate number.
14134	...determine whether to add or subtract the resulting equations so as to eliminate one variable.
14135	...add or subtract the two equations so as to eliminate one variable.
14136	...solve for the second variable by substituting the value already found for the first in one of the equations.
14137	...check the solution by substituting both values in both equations.
14140	...transform each equation of the pair of simultaneous linear equations in two variables into the form $ax + by = c$.
14141	...multiply both members of the equation by the lowest common denominator to remove any fractions.
14142	...combine simultaneous and add or subtract appropriate quantities by using the addition and subtraction - properties of equality to give a result in the form $ax + by = c$.

MBO LIST

Upon completion of this segment, the student should be able to:

MBO CODE	
14210	...solve a pair of simultaneous linear equations in two unknowns by the substitution method.
14211	...determine in which equation of a pair of simultaneous linear equations in two unknowns, solution for one variable in terms of the other would be simpler.
14212	...solve one equation for one variable in terms of the other variable.
14213	...substitute the algebraic value obtained for one variable from one equation in the other equation, so as to produce a third equation in one variable.
14214	...solve the resulting equation in one variable for that variable.
14215	...substitute the solution for this variable in one of the original equations and solve for the remaining variable.
14216	...check by substituting the values found for each variable in both of the original equations.

MBO LIST

Upon completion of this segment, the student should be able to:

MBO CODE	
14310	...graph in the Cartesian plane an inequality in one or two variables.
14311	...transform an inequality to an equality by replacing the inequality sign with an equals sign.
14312	...recognize and apply the principle: the equation derived by transforming an inequality to an equation is called the equation of the reference line.
14313	...graph the reference line.
14314	...recognize that the graph of an inequality in two variables is one of the two half-planes formed by the reference line.
14315	...recognize that the graph of an inequality which contains only the variable y is that half-plane either above or below the hortizontal reference line.
14316	...recognize that the graph of an inequality which contains only the variable x is that half-plane either to the right or left of the vertical reference line.
14317	...recognize that the reference line is to be dotted unless the equal sign also appeared with the inequality.
14320	...solve graphically a set of linear inequalities in two unknowns.
14321	...represent the solution of each inequality by a different method of shading of the half-plane.
14322	...recognize the region where the individual solutions overlap, as the solution of the set of the two given inequalities.

MBO LIST

Upon completion of this segment, the student should be able to:

MBO CODE	
14410	...solve verbal problems by using two variables and one of the three methods for solving simultaneous linear equations.
14411	...solve number relationship problems using two variables.
14412	.. solve perimeter problems using two variables.
14413	...solve purchasing problems using two variables.
14414	...solve investment problems using two variables.
14415	...solve mixture problems using two variables.
14416	...solve coin problems using two variables.

MBO LIST

Upon completion of this segment, the student should be able to:

MBO CODE	
14510	...determine the equation of a line whose graph in the Cartesian plane goes through two points which have the same abscissa.
14511	...recognize that points with the same abscissa lie on a line parallel to the Y axis.
14512	...recognize that the equation of a line parallel to the Y axis is of the form $x = k$.
14520	...determine the equation of a line whose graph in the Cartesian plane goes through two points which have the same ordinate.
14521	...recognize that points with the same ordinate lie on a line parallel to the X axis.
14522	...recognize that the equation of a line parallel to the X axis is of the form $y = k$.
14530	...determine the equation of a line whose graph in the Cartesian plane passes through two points which have different abscissas or different ordinates or both.
14531	...recognize and apply the principle: the equation for a line can be written in the form $y = mx + b$.
14532	...substitute the values of x and y, which are the coordinates of the two points on the graph of the line in the equation after it has been put in the form $y = mx + b$.

MBO LIST

Upon completion of this segment, the student should be able to:

MBO CODE	
14533	...solve the simultaneous equations to find the values of m and of b.
14534	...write the equation of the line.
14535	...check that the coordinates of the points fit the resulting equation.

MBO LIST

Upon completion of this segment, the student should be able to:

MBO CODE	
15110	...solve verbally posed digit problems concerning the relationships of the digits, the reverse number and the number itself.
15111	...express a two digit number in the form: $10t + u$.
15112	...recognize and apply the principle: the place value of the units digit is equal to its face value.
15113	...recognize and apply the principle: the place value of the tens digit is ten times its face value.
15114	...express the sum of the digits in the form: $t + u$
15115	...express the reversed number in the form: $10u + t$
15116	...recognize and apply the principle: changing the order of the digits changes the place value but not the face value of the digits.
15117	...express verbal statements of relations between the digits as equations.
15118	...translate into verbal form any equation concerning the digits, the number, or the reversed number.

MBO LIST

Upon completion of this segment, the student should be able to:

MBO CODE	
15210	...solve verbally posed constant motion problems involving compound rates along the same line of motion, e.g. "boat-in-stream" problems.
15211	...recognize and apply the principle: the relationship involved in constant linear motion problems is rate times time equals distance.
15212	...recognize and apply the principle: the effective rate downstream of a boat is the sum of two rates: the basic rate of the boat in stillwater plus the rate of the stream.
15213	...recognize and apply the principle: the effective rate upstream of a boat is the difference of two rates: the basic rate of the boat in still water minus the rate of the stream.
15214	...recognize and apply the principle: a "round trip" indicates that the distance upstream equals the distance downstream.
15215	...recognize and apply the principle: the units in a constant motion problem must be consistent. e.g. m miles per hour for h hours equals mh miles; a feet per second for b seconds equals ab feet; s miles per hour in still water + c miles per hour of the current equals s + c miles per hour downstream.

MBO LIST

Upon completion of this segment, the student should be able to:

MBO CODE	
15310	...solve verbally posed age problems involving two variables.
15311	...express the age of each person by a different variable.
15312	...recognize and apply the principle: at a time"a" years in the future, the age of each person will be "a" greater than at present.
15313	...recognize and apply the principle: at a time "b" years ago, the age of each person was "b" less than at present.
15314	...recognize and apply the principle: the difference between the ages of two people is an invariant at any time of their lives.
15315	...recognize and apply the principle: the ratio of the ages of two people varies with time.
15316	...express as an algebraic equation a given relationship between the ages of two persons.

MBO LIST

Upon completion of this segment, the student should be able to:

MBO CODE	
15320	...solve verbally posed problems about fractions.
15321	...represent numerator and denominator by different variables.
15322	...recognize that the value of a fraction determines only the ratio between the numerator and the denominator.
15323	...express the reciprocal of a given fraction as a function of the original numerator and denominator.
15324	...express as an algebraic equation a given relationship between the numerator and denominator of a fraction.

MBO LIST

Upon completion of this segment, the student should be able to:

MBO CODE	
15410	...recognize the characteristics of the set of natural numbers.
15411	...recognize that the set of natural numbers is equivalent to the set of positive integers.
15412	...recognize that the set of positive integers is closed under addition and multiplication.
15413	...recognize that the set of positive integers is not closed under subtraction or division.
15420	...recognize the characteristics of the set of rational numbers.
15421	...define a rational number as the quotient of two integers $\frac{a}{b}$ where the $b \neq 0$.
15422	...recognize that division by zero is not defined.
15423	...recognize that the set of rational numbers is closed under addition, subtraction, multiplication and division.
15430	...recognize that any two rational numbers are either equal, or can be put in order of size.
15431	...reduce a fraction to lowest terms.
15432	...recognize whether or not two rational numbers are equal by reducing them to lowest terms.
15433	...recognize which of two unequal rational numbers is larger by using the principle: $\frac{a}{b} > \frac{b}{d}$ if and only if $ad > bc$.

MBO LIST

Upon completion of this segment, the student should be able to:

MBO CODE:

15434 ...recognize that there is an infinite set of rational numbers between two given numbers.

15435 ...find a rational number between two given unequal rational numbers.

15440 ...recognize that every rational number can be expressed as a decimal, and it will either be terminating or repeating but non-terminating.

15441 ...transform a rational number into decimal form by division.

15442 ...represent a repeating decimal by means of the bar notation,

e.g. $\frac{1}{12} = .08333... = .08\overline{3}$

15450 ...recognize that every finite decimal, or infinite repeating decimal is a rational number and can be written as a common fraction.

15451 ...transform a finite decimal to a common fraction by learning that the number of decimal places indicates the power of 10 in the denominator.

e.g. $.173 = \frac{173}{1000}$

15452 ...transform an infinite repeating decimal to a common fraction:

e.g. $.\overline{43} = \frac{43}{99}$

15453 ...round off an infinite decimal to a specified number of places.

$.\overline{6} = .6666... = .67$ to two decimal places

MBO LIST

Upon completion of this segment, the student should be able to:

MBO CODE	
15510	..recognize the meaning of a root of a number for an index of 2 , 3 or 4 .
15511	...find the positive and negative square root of a perfect square.
15512	..recognize and apply the principle: the radical alone indicates the positive value of the square root, e.g. $\sqrt{16} = +4$
15513	...calculate the square root of a product by taking the square root of each factor, e.g. $\sqrt{a \cdot b} = \sqrt{a} \cdot \sqrt{b}$
15514	...calculate the square root of a quotient by taking the square root of a numerator and divisor, e.g. $\sqrt{\frac{a}{b}} = \frac{\sqrt{a}}{\sqrt{b}}$
15520	...define an irrational number as a non-terminating, non-repeating decimal.
15521	...recognize that, if a number is not a perfect square, its square root is irrational.
15522	...calculate the value of an irrational square root to the nearest tenth.
15523	...find the square root of a number from a table.
15530	...define a real number as a number which is either rational or irrational.
15531	...recognize that all the numbers dealt with in this course are real numbers.

MBO LIST

Upon completion of this segment, the student should be able to:

MBO CODE	
16110	...calculate the length of the missing side of a right triangle given the length of two sides.
16111	...recognize and distinguish between the hypotenuse, which is the side opposite the right angle in a right triangle, and the legs, which are the sides that form the right angle, of a right triangle.
16112	...substitute two given values for the sides of a right triangle, in the Pythagorean theorem formula: $leg^2 + leg^2 = hyp^2$, and calculate the missing value.
16120	...construct a diagram representing the data as a geometric diagram involving a right triangle.
16121	...recognize that each given length is represented as a straight line segment.
16122	...recognize and apply the principle: in verbal problems involving the solution of right triangles, a wall, telephone pole, tree, and such, are assumed to form right angles with the ground, unless otherwise stated.
16123	...recognize that, in verbal problems, a ladder leaning against a wall is assumed to form the hypotenuse of a right triangle.
16124	...recognize that, in verbal problems, a shadow is assumed to be on the horizontal ground.
16125	...recognize the position of the "foot of the pole" or tree or buildings as the point of intersection of the line representing them with the line representing the ground.
16126	...recognize that, if a point is on the ground, its distance from the foot of the pole is the distance measured along the ground.

MBO LIST

Upon completion of this segment, the student should be able to:

MBO CODE	
16210	...recognize and apply the principle: the product of the indicated square roots of any two positive numbers is the square root of the product of those numbers. e.g. $\sqrt{a}\sqrt{b} = \sqrt{ab}$
16211	...recognize and apply the principle: a radical multiplied by itself equals the radicand, e.g. $(\sqrt{a})^2 = \sqrt{a}\sqrt{a} = a$
16212	...recognize and apply the principle: the product of two radicals having coefficients is the product of the coefficients times the radical whose radicand is the product of the radicands, e.g. $a\sqrt{b} \quad c\sqrt{d} = ac\sqrt{bd}$
16213	...recognize and apply the principle: the square root of the square of a positive number is the number itself, e.g. $\sqrt{a^2} = a$
16214	...recognize and apply the principle: a radical having a radicand with a perfect square as a factor can be transformed to the product of the square root of the perfect square and the radical whose radicand contains the remaining factors, e.g. $\sqrt{a^2b} = a\sqrt{b}$
16215	...recognize and apply the principle: the symbol $\sqrt{a}$ means the square root of "a," the symbol "$\sqrt{\ }$" is called a "radical sign" and "a" is called the "radicand." In this course "a" cannot be negative.
16216	...recognize and apply the principle: the indicated square root of a number will be referred to as a "radical" in this course, e.g. $\sqrt{a}$ is a radical and it can be referred to as "radical a ."

MBO LIST

Upon completion of this segment, the student should be able to:

MBO CODE

16220 ...recognize and apply the principle: the quotient of two square root radicals is the square root of their quotient

$$\frac{\sqrt{a}}{\sqrt{b}} = \sqrt{\frac{a}{b}} \qquad \text{where } b > 0$$

16221 ...recognize and apply the principle: a radical divided by itself = 1.

$$\frac{\sqrt{a}}{\sqrt{a}} = 1 \qquad \text{where } a > 0$$

16222 ...recognize and apply the principle: the quotient of two radicals having coefficients is the quotient of the coefficients times the radical whose radicand is the quotient of the radicands, e.g.

$$\frac{a\sqrt{b}}{c\sqrt{d}} = \frac{a}{c}\sqrt{\frac{b}{d}} \qquad \text{where } d > 0$$

16223 ...recognize and apply the principle: a fraction containing a radical in the denominator can be rationalized by multiplying the numerator and denominator by a radical that makes the denominator a rational number

e.g. $$\frac{a}{\sqrt{b}} = \frac{a\left(\sqrt{b}\right)}{\sqrt{b}\left(\sqrt{b}\right)} = \frac{a\sqrt{b}}{b} \qquad \text{where } b > 0$$

16224 ...find the smallest number which can be used as a multiplier in rationalizing the denominator of a fraction containing a radical.

MBO LIST

Upon completion of this segment, the student should be able to:

MBO CODE	
16310	...add and subtract like radicals.
16311	...recognize that two radicals are alike when the radicands are identical.
16312	...recognize and apply the principle: adding terms with radicals is analagous to adding terms with letters.
16313	...recognize that unlike radicals can be combined only if they can be simplified to produce like radicals.
16314	...recognize that unlike radicals cannot be combined if they cannot be transformed into like radicals.

MBO LIST

Upon completion of this segment, the student should be able to:

MBO CODE	
16410	...multiply binomials containing radicals.
16411	...recognize that $a + \sqrt{b}$ or $\sqrt{a} + b$ are binomials.
16412	...recognize and form the conjugate of a binomial containing a radical. e.g. the conjugate of $a + \sqrt{b}$ is $a - \sqrt{b}$ and the pair are called conjugate binomials.
16413	...recognize and apply the principle: the product of conjugate binomials is a rational quantity. e.g. $(a + \sqrt{b})(a - \sqrt{b}) = a^2 - b$
16414	...recognize that squaring a binomial containing radicals of the form $a + \sqrt{b}$ where b is not a square produces an irrational result. e.g. $(a + \sqrt{b})^2 = a^2 + b + 2a\sqrt{b}$
16415	...multiply a radical by a binomial containing radicals by using the distributive law. e.g. $\sqrt{a}(b + \sqrt{c}) = b\sqrt{a} + \sqrt{ac}$
16416	...multiply two non-conjugate binomials containing radicals. e.g. $(a + \sqrt{b})(c + d\sqrt{b})$ $(ac + bd) + (ad + c)\sqrt{b}$

MBO LIST

Upon completion of this segment, the student should be able to:

MBO CODE	
16420	...rationalize the denominator of a fraction when that denominator is a binomial containing radicals. e.g. $\frac{a}{b + \sqrt{c}} = \frac{a(b - \sqrt{c})}{b^2 - c}$
16421	...find the conjugate of the denominator of a fraction that is a binomial containing radicals.
16422	...rationalize the denominator of a fraction when the numerator is rational.
16423	...rationalize the denominator of a fraction when the numerator is a monomial radical. e.g. $\frac{\sqrt{a}}{b + \sqrt{c}} = \frac{b\sqrt{a} - \sqrt{ac}}{b^2 - c}$
16424	...rationalize the denominator of a fraction when the numerator is a binomial radical. e.g. $\frac{\sqrt{a} + \sqrt{b}}{c - \sqrt{d}} = \frac{c\sqrt{a} + c\sqrt{b} + \sqrt{ad} + \sqrt{bd}}{c^2 - d}$
16430	...find the solution of a radical equation, where only a single term contains the radical. e.g. $a + \sqrt{x} = b$
16431	...transform an equation containing a radical so that the term containing the radical is alone on one side of the equation. e.g. $a + \sqrt{x} = b$ because $\sqrt{x} = b - a$
16432	...transform an equation containing a radical by squaring both sides of the equation. e.g. $\sqrt{x} = b$ because $x = b^2$
16433	...solve a non-radical equation.
16434	...check each solution obtained from an equation containing a radical and discard any value which does not check in the original equation.

MBO LIST

Upon completion of this segment, the student should be able to:

MBO CODE	
16510	...define a relation between two variables as a set of ordered pairs. e.g. $y = 2x + 1$ is the set $\{(0,1), (1,3), (2,5)...\}$.
16511	...define the domain of the relation as the first element of the relation.
16512	...define the range of the relation as the second element of the relation.
16513	...recognize that a relation can often be expressed as an equation.
16514	...write an equation, given a roster of a simple relation, e.g. $y = x + 1$
16520	...define a function as a special kind of relation, where each member of the domain is paired with only one member of the range.
16521	...find the domain, given a graph of the function.
16522	...find the range, given a graph of the function.
16523	...write the equation of a linear function which is described in words.
16524	...graph the function (linear) if it is expressed as an equation.

MBO LIST

Upon completion of this segment, the student should be able to:

MBO CODE	
16530	...solve verbal problems dealing with direct variation, by means of the equation $y = kx$.
16531	...recognize and apply the principle: $y = kx$ expresses direct variation.
16532	...recognize that the graph of direct variation is a straight line.
16533	...express as an equation a verbal statement involving direct variation.
16534	...recognize that the principle of direct variation is involved where one variable increases when the other increases, and where the first decreases when the other decreases.
16540	...solve verbal problems dealing with direct variation by means of a proportion.
16541	...recognize that the proportion $\frac{Y_1}{Y_2} = \frac{X_1}{X_2}$ indicates direct variation.
16542	...recognize that a proportion is an equation of two ratios.
16543	...define the term "means" as Y_2 and X_1 in the proportion $\frac{Y_1}{Y_2} = \frac{X_1}{X_2}$
16544	...define the term "extremes" as Y_1 and X_2 in the proportion $\frac{Y_1}{Y_2} = \frac{X_1}{X_2}$
16545	...recognize that in a proportion the product of the means equals the product of the extremes.
16546	...express as a proportion a verbal statement involving direct variation.

MBO LIST

Upon completion of this segment, the student should be able to:

MBO CODE	
17110	...solve verbal problems involving inverse variation between the two variables x and y by means of the equation $y = \frac{k}{x}$ where k is a constant.
17111	...express as an equation a verbal statement involving inverse variation.
17112	...recognize and apply the principle: $y = \frac{k}{x}$ expresses inverse variation.
17113	...recognize that the graph on Cartesian Coordinates, of inverse variation is a hyperbola. (not a straight line)
17114	...recognize and apply the principle: inverse variation is involved where one variable increases when the other decreases, while the product of the paired values remains constant.
17120	...solve verbal problems dealing with inverse variation by means of a proportion.
17121	...recognize and apply the principle: the proportion: $\frac{Y_1}{Y_2} = \frac{X_2}{X_1}$ indicates inverse variation involving the ordered pair, (X_1Y_1) and (X_2Y_2)
17122	...express as a proportion a verbal statement involving inverse variation.

MBO LIST

Upon completion of this segment, the student should be able to:

MBO CODE	
17130	...solve verbal problems involving the joint variation, of the variables x, y, and z, by means of the equation $z = kxy$ where k is a constant.
17131	...express as an equation a verbal statement involving the joint variation of three variables.
17132	...recognize that $z = kxy$ indicates joint variation, i.e. z varies directly as the product of x and y.
17140	...solve verbal problems involving the joint variation of three variables by means of a proportion.
17141	...express as a proportion a verbal statement involving joint variation.
17142	...recognize that joint variation of the two order triple $(X_1Y_1Z_1)$ and $(X_2Y_2Z_2)$, can be expressed as a proportion, e.g. $\frac{Z_1}{Z_2} = \frac{X_1 Y_1}{X_2 Y_2}$
17150	...solve verbal problems involving combined variation of three variables.
17151	...recognize and apply the principle: combined variation can be expressed by the equation: $ZY = KX$ where K is a constant.
17152	...recognize and apply the principle: combined variation of the two ordered triples, $(X_1Y_1Z_1)$ and $(X_2Y_2Z_2)$ can be expressed by the proportion: $\frac{Z_1}{Z_2} = \frac{X_1Y_2}{X_2Y_1}$

MBO LIST

Upon completion of this segment, the student should be able to:

MBO CODE	
17210	...solve a quadratic equation of the type $ax^2 - c = 0$ for the variable x where a and c are constant, and $a > 0$, $c > 0$
17211	...recognize and apply the principle: $x = +s$, $x = -s$ are solutions to the quadratic equation $x^2 = s^2$
17212	...transform an equation from the form $ax^2 - c = 0$ to the form $x^2 = +\frac{c}{a}$ where $c > 0$, $a > 0$
17213	...recognize that the solution of $x^2 = +\frac{c}{a}$ may be rational or irrational and in the form: $x = \pm\sqrt{\frac{c}{a}}$ where $c > 0$, $a > 0$
17214	...check the solutions by substitution in the original quadratic equation.
17215	...recognize that some quadratic equations of the form: $ax^2 - c = 0$ do not have solutions in the real number system. e.g. $x^2 = \frac{+c}{a}$ when: $c < 0$, $a > 0$
17220	...solve quadratic equations of the form $(ax + b)^2 = c$ for x where $a > 0$, $c > 0$, by taking the square root of both sides of the equations.
17221	...recognize that in the solving of equations of the form $(ax + b)^2 = c$, for x $a \neq 0$, $c > 0$, two linear equations result. i.e. $ax + b = +\sqrt{c}$ and $ax + b = -\sqrt{c}$
17222	...solve the derived linear equations, of the form $ax + b = \pm\sqrt{c}$ resulting from taking the square root of both sides of the quadratic equation.
17223	...check the solutions by substituion, in the original quadratic equation.

MBO LIST

Upon completion of this segment, the student should be able to:

MBO CODE	
17310	...transform a quadratic polynomial of the form $x^2 + bx$ into a perfect trinomial square by "completing the square".
17311	...recognize and apply the principle: the square of $\frac{1}{2}b$ must be added to $x^2 + bx$ to produce a perfect trinomial square.
17312	...express a perfect trinomial square as the square of a binomial e.g. $x^2 + bx + (\frac{1}{2}b)^2 = (x + \frac{1}{2}b)^2$
17320	...solve a quadratic equation of the form $x^2 + bx + c = 0$ by completing the square (real roots), using the following sequence of operations:
17321	transform the equation $x^2 + bx + c = 0$ into the form $x^2 + bx = -c$ by subtracting c from both sides.
17322	add $\frac{b^2}{4}$ to both sides of the equation, $x^2 + bx = -c$
17323	express the left side as the square of a binomial: $(x + \frac{b}{2})^2$
17324	express the right side as a single term: $\frac{b^2 - 4c}{4}$
17325	write the two linear equations resulting from taking the square roots of both sides.
17326	solve the linear equations.
17327	check the solutions by substitution.
17328	calculate the value of irrational roots correct to the nearest tenth.

MBO LIST

Upon completion of this segment, the student should be able to:

MBO CODE	
17410	...solve quadratic equations of the form $ax^2 + bx + c = 0$ by completing the square, using the following sequence of operations:
17411	transform the equation so that the coefficient of x^2 is 1 by dividing both sides of the equation by a.
17412	transform the equation by completing the square.
17413	solve the resulting equation by taking the square roots of both sides.
17414	check the solutions by substitution.
17415	recognize that the process of completing the square permits the solution of any quadratic equation with real roots.
17420	...solve fractional equations which transform into quadratic equations, using the following sequence of operations:
17421	transform a fractional equation by multiplying both sides of the equation by the LCD of all the fractions.
17422	transform the equation into the form $ax^2 + bx = c$.
17423	solve the resulting equation by completing the square.

MBO LIST

Upon completion of this segment, the student should be able to:

MBO CODE	
17430	...solve verbal problems leading to quadratic equations, where the roots are irrational, in the following applications:
17431	solve area problems.
17432	solve problems involving right triangles.
17433	solve purchasing problems.
17434	solve motion problems.

Upon completion of this segment, the student should be able to:

MBO CODE

17510 ...derive the quadratic formula: if $ax^2 + bx + c = 0$, then $x = \frac{b \pm \sqrt{b^2 - 4ac}}{2a}$ using the following sequence of operations:

17511 transform the equation $ax^2 + bx + c = 0$ by dividing both sides of the equation by a.

17512 transform the derived equation by subtracting $\frac{c}{a}$ from both sides of the equation.

17513 transform the resulting equation by adding $\frac{b^2}{4a^2}$ to both sides.

17514 express the resulting equation in the form: $\left[x + \frac{b}{2a}\right]^2 = \frac{b^2 - 4ac}{4a^2}$

17515 transform the resulting equation by taking the square root of both sides, getting two linear equations.

17516 transform the resulting equation by subtracting $\frac{b}{2a}$ from both sides.

17520 ...solve any quadratic equation with real roots by means of the quadratic formula, using the following sequence of operations:

17521 write the quadratic formula.

17522 transform a quadratic equation into the form $ax^2 + bx + c = 0$

17523 find the values of a, b, and c.

17524 substitute the values of a, b, and c into the formula.

17525 calculate the exact values of the solutions.

17526 calculate values to the nearest tenth, when the solutions are irrational.

PMC IX

MBO LIST

Upon completion of this segment, the student should be able to:

MBO CODE	
17530	...solve verbal problems leading to quadratic equations with irrational roots, in the following applications:
17531	solve area problems.
17532	solve problems involving right triangles.
17533	solve purchasing problems.
17534	solve motion problems.

MBO LIST

Upon completion of this segment, the student should be able to:

MBO CODE	
18110	...recognize certain basic geometric concepts, as follows:
18111	recognize that a point has a position, but no size.
18112	recognize that a line has only length and that it extends indefinitely.
18113	recognize that a plane has only two dimensions and that it extends indefinitely.
18114	recognize that a line segment is a portion of a line with two end points.
18115	recognize that an angle is an amount of rotation between two intersecting lines.
18120	...recognize proper nomenclature for line segments and angles, as follows:
18121	recognize a point named by a capital letter placed near it.
18122	recognize a line segment named by the capital letters of its endpoints.
18123	recognize a line segment named by a small letter placed near the segment.
18124	recognize an angle named by the capital letter at the vertex.
18125	recognize an angle named by a small letter placed inside the angle near the vertex.

MBO LIST

Upon completion of this segment, the student should be able to:

MBO CODE	
18210	...solve prob[illegible] involving similar triangles using the following sequence of operations:
18211	recognize that triangles are similar if two pairs of corresponding angles are equal.
18212	recognize that if two triangles are similar, their corresponding sides are in proportion.
18213	write a proportion involving the sides of two similar triangles.
18214	solve the proportion.
18220	...solve verbal problems involving similar triangles, using the following sequence of operations:
18221	recognize the position of the right angles in shadow problems.
18222	recognize that all right angles are equal.
18223	recognize the vertical angles in the diagram for finding the distance across a stream.
18224	recognize and apply the principle: vertical angles are equal.
18225	find the similar triangles in the diagram made from the verbal problem.
18226	write a proportion involving the sides of the similar triangles.
18227	solve the proportion.

MBO LIST

Upon completion of this segment, the student should be able to:

MBO CODE	
18310	...recognize and apply the principle: a ratio of two numbers is the quotient of one divided by the other.
18311	...recognize and apply the principle: a ratio of two denominate quantities expressed in the same units is the quotient of one divided by the other.
18312	...reduce a ratio to lowest terms.
18313	...recognize that the ratio between two numbers does not determine the value of either number.
18314	...recognize that the order of the numbers in a ratio is important.
18320	...solve verbal problems involving ratios.
18321	...represent two quantities in the ratio a:b as ax and bx .
18322	...represent two quantities where one is a given fraction of the other: e.g. if one is $\frac{2}{3}$ of the other number, represent them as 2x and 3x .

MBO LIST

Upon completion of this segment, the student should be able to:

MBO CODE

18410 ...define the tangent function of an acute angle in a right triangle as the ratio of the length of the opposite leg to the length of the adjacent leg.

18411 ...recognize that the tangent function refers to a particular angle in a right triangle.

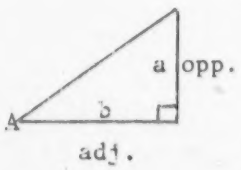
18412 ...recognize that the hypotenuse is the side opposite the right angle.

18413 ...recognize the "opposite leg" is the side opposite the particular acute angle.

18414 ...recognize that the "adjacent leg" is the leg adjacent to the particular acute angle.

18420 ...find a missing leg in a right triangle when given one acute angle and the other leg, using the following sequence of operations:

18421 locate and label the particular angle involved, the hypotenuse, the opposite leg, and the adjacent leg.



18422 write the equation of the form $\tan A = \frac{a}{b}$

18423 substitute values of the angle and the known leg in the equation.

18424 find the value of tan A in the table.

18425 substitute the value for tan A in the equation.

18426 solve the equation for the missing quantity and round off as directed.

18427 recognize that when the denominator involves the variable, a long division will result.

18428 solve an equation of the type:

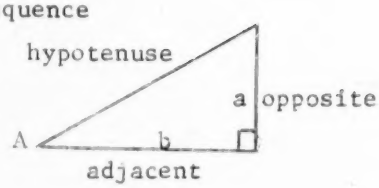
$$.4012 = \frac{24}{x}$$

MBO LIST

Upon completion of this segment, the student should be able to:

MBO CODE

18430 ...find an acute angle of a triangle given the two legs, using the following sequence of operations:



18431 locate and label the hypotenuse, opposite leg, and adjacent leg.

18432 write the equation in the form

$$\tan A = \frac{a}{b}$$

18433 convert the fraction $\frac{a}{b}$ to a four place decimal.

18434 write the equation in the form tan A = decimal.

18435 locate the nearest entry in the tan column of the table.

18436 write the result in the form A = .. expressing the angle to the nearest degree.

18440 ...solve verbal problems involving an angle of elevation or an angle of depression in a properly labeled diagram using the following sequence of operations:

18441 find the horizontal line in the diagram, drawing it in, if necessary.

18442 recognize that the angle of elevation is at the bottom of the diagram rotating upward from the horizontal.

18443 recognize that the angle of depression is at the top of the diagram rotating downward from the horizontal.

18444 recognize that the angle of elevation and the angle of depression are equal since they form alternate interior angles.

18445 choose the right triangle in which either one leg and one acute angle are known, or two legs are know.

18446 write an equation using the tangent function.

18447 solve the equation, and round off properly.

MBO LIST

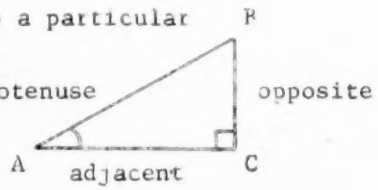
Upon completion of this segment, the student should be able to:

MBO CODE

18510 ...define the sine function of an acute angle in a right triangle as the ratio of the opposite leg to the hypotenuse. The cosine function of an acute angle in a right triangle is the ratio of the adjacent leg to the hypotenuse.

18511 ...recognize that each function refers to a particular acute angle in a right triangle.

18512 ...locate and label hypotenuse, opposite leg and adjacent leg.



18520 ...find a missing leg in a right triangle in which hypotenuse and one acute angle are given, using the following sequence of operations:

18521 locate and label the particular angle, opposite leg, hypotenuse, adjacent leg.

18522 choose the sine function if the opposite leg is to be found

18523 choose the cosine function if the adjacent leg is to be found.

18524 write the equation $\sin A = \frac{a}{c}$ or $\cos A = \frac{b}{c}$

18525 substitute the values for A and C.

18526 find the value of sin A or cos A in the table.

18527 substitute the value in the equation.

18528 solve the equation.

18530 ...find the hypotenuse in a right triangle in which one leg and one acute angle are given, using the following sequence of operations:

18531 locate and label the particular angle, hypotenuse, opposite leg and adjacent leg

18532 choose sine function if opposite leg is known.

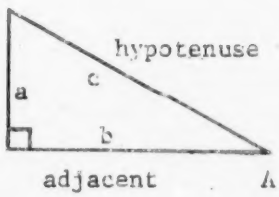
18533 choose cosine if adjacent leg is known.

18534 write the equation $\sin A = \frac{a}{c}$ or $\cos A = \frac{b}{c}$

MBO LIST

Upon completion of this segment, the student should be able to:

MBO CODE	
18535	substitute values for A and a or b in the equation.
18536	find the value of sin A or of cos A in the table.
18537	substitute the value in the equation.
18538	recognize that there will be a long division in the solution of the equation.
18539	solve the equation.
18540	...find an acute angle in a right triangle, given the hypotenuse and one leg, using the following sequence of operations:
18541	locate and label the particular angle, hypotenuse, opposite leg and adjacent leg.
18542	choose sine or cosine depending on whether the known leg is opposite leg or adjacent leg.
18543	write the equation $\sin A = \frac{a}{c}$ or $\cos A = \frac{b}{c}$.
18544	substitute values for a and c or b and c.
18545	divide to change the fraction to a 4 place decimal.
18546	write the equation in the form sin A = decimal or cos A = decimal.
18547	locate nearest entry in the proper column of the table.
18548	write the result, A = ... giving value to the nearest degree.



MBO LIST

Upon completion of this segment, the student should be able to:

MBO CODE	
18550	...solve verbal problems dealing with right triangles where one acute angle and two sides are involved, using the following sequence:
18551	draw diagrams and label with given information.
18552	choose the right triangle in which two quantities are known (not both angles.)
18553	locate and label the particular angle, hypotenuse, opposite leg and adjacent leg
18554	decide which two sides of the triangle are involved.
18555	choose the sine, cosine or tangent function depending on the pair of involved sides.
18556	write the equation using the proper function.
18557	solve the equation, rounding off properly.